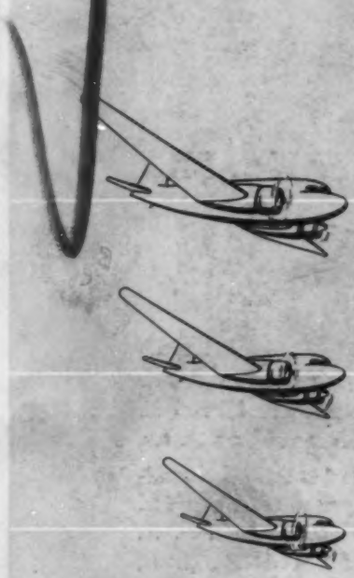
Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

TECHNOLOGY DEPT.

OCTOBER, 1946

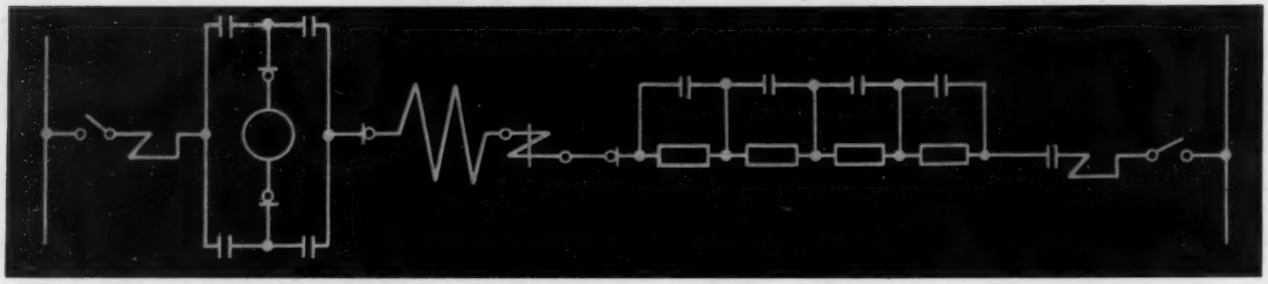


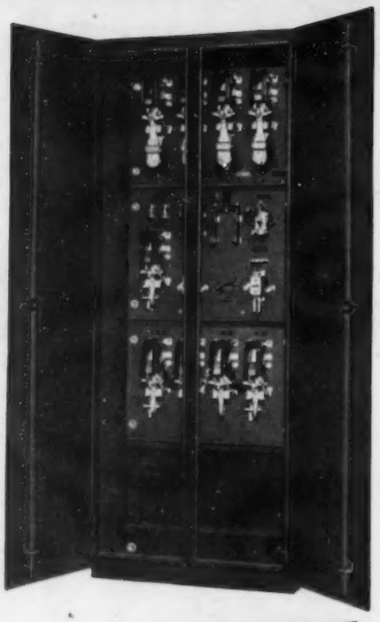
18,000 TON DIE-FORGING PRESS
FOR MAGNESIUM AND LIGHT ALLOYS
Designed, Built and Installed Complete by **MESTA**

MESTA MACHINE CO.
PITTSBURGH, PA.

What control for what mill equipment? One of a SERIES of advertisements featuring basic heavy duty power circuits . . . and showing Cutler-Hammer's broad design and application experience which has made it the preferred control for the steel industry.

When you have a crane application that calls for accurate stopping of bridge and trolley . .





Then ask for Cutler-Hammer No. 14111 D. C. Reversing Plugging Control *with Rectifier Plugging*

Cutler-Hammer engineers have designed this simple, rugged mill control for series wound motors that drive crane bridge and trolley or other equipment that must be stopped and reversed frequently, rapidly and accurately.

Besides using the well-known C-H *Ltl* Inductive Time Limit acceleration, this control employs rectifier plugging for fast, accurate stops. The master inherently provides several operating speeds with speed reduction up to 50%. An optional, low creeping speed can also be supplied.

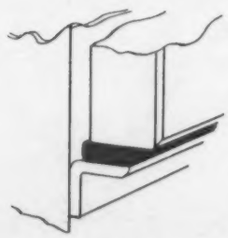
Mill maintenance men like Bulletin 14111 because of its ruggedness and simplicity of design. They also like the mechanical features, a few of which are shown below.

Dependable 14111 is the product of long years of diversified Mill Control experience. . . . . CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

CUTLER-HAMMER
MOTOR CONTROL
C-H

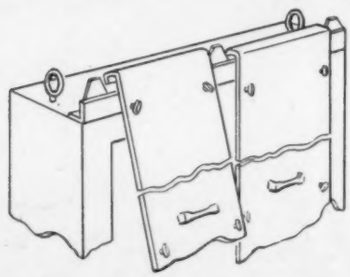
CHECK these mechanical components as well

Shock-proof frame



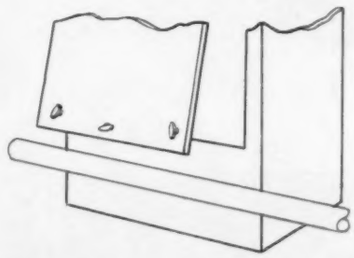
An important detail is the C-H Shock-Proof Frame. Here, special angles, welded to the frame support each Unit Panel on a resilient mounting base.

Easy-on, easy-fasten back plate



Back plate hooks on at top and is self-aligning. With this and captive wing nuts, maintenance men find it easy to remove.

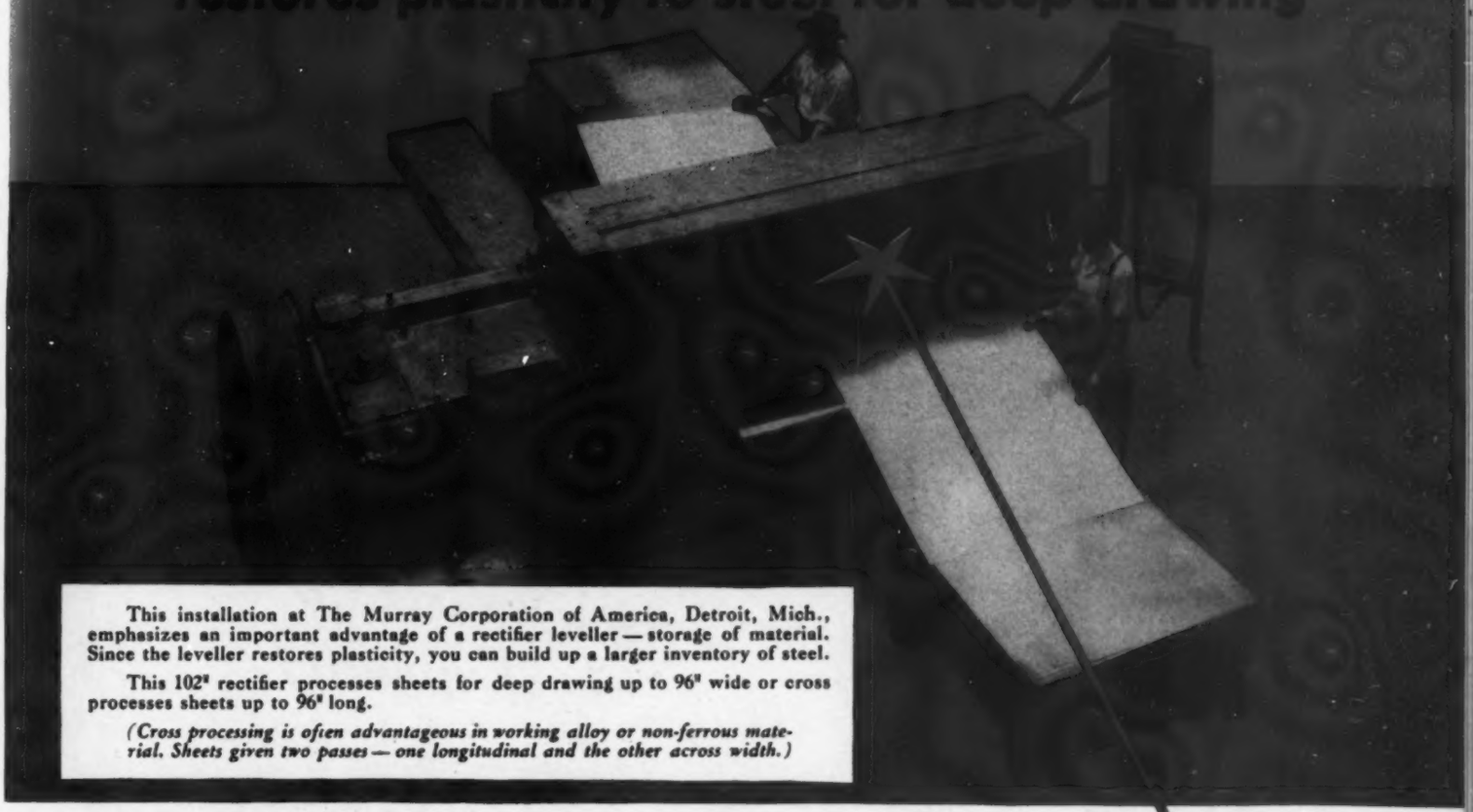
Shaft-clearing short back plate



Another feature mill men like is the C-H short back plate that clears the crane bridge drive shaft.

RECTIFIER LEVELLER

restores plasticity to steel for deep drawing



This installation at The Murray Corporation of America, Detroit, Mich., emphasizes an important advantage of a rectifier leveller — storage of material. Since the leveller restores plasticity, you can build up a larger inventory of steel.

This 102" rectifier processes sheets for deep drawing up to 96" wide or cross processes sheets up to 96" long.

(Cross processing is often advantageous in working alloy or non-ferrous material. Sheets given two passes — one longitudinal and the other across width.)

Properly rectified, blanks, sheets or strip take a deep draw easily. 15 individual flexing operations, each equivalent to bending around an individual roll of slightly larger diameter, restore much of the original plasticity, thereby eliminating most hand finishing after drawing.

Blanks of any shape, sheets or strip can be uniformly processed without distortion. There is no unprocessed portion of the leading end of the material.

Entering brush rolls and automatic spray cleans and oil-coats the material as the steel moves through the rectifier leveler.

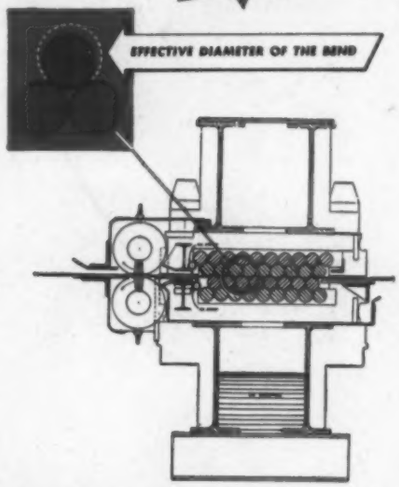
Aetna-Standard, largest manufacturers of levellers, developed the rectifier leveller 13 years ago for the automobile industry. Since then, many improvements have been made in the original design. Put a rectifier leveller to work for you and eliminate many deep drawing headaches. Ask Aetna-Standard for recommendations.

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries

THE AETNA-STANDARD ENGINEERING CO. YOUNGSTOWN, OHIO

ASSOCIATED COMPANY

HEAD, WRIGHTSON & COMPANY, LIMITED MIDDLESBOROUGH, ENGLAND



As every increment of the material flows through the effective bend area, no further increase in the wrap around roll can increase the internal work in the material. The smaller diameter roll used, the greater the processing obtained. We use smallest diameter rolls practical for the gauges to be processed. 57 backing up rolls and 114 bearings permit use of these extremely small diameter work rolls.

Aetna-Standard

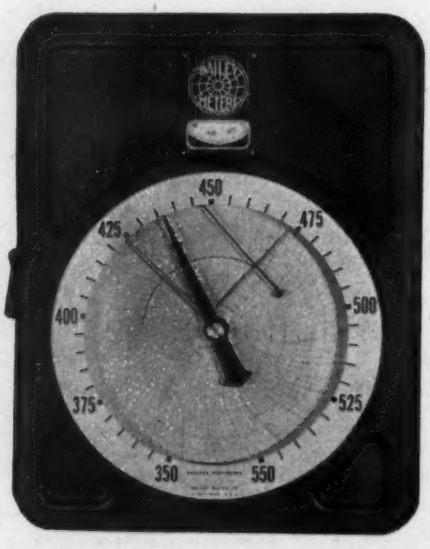
NEW!

Measure and Control

Temperature
Pressure
Level
Flow
Flow Ratio

Speed
Conductivity or pH
Per Cent Oxygen
Per Cent Combustibles
Motion or Position

with STANDARDIZED Electronic Instruments



Standardized Bailey Electronic Instrument for indicating, recording and controlling the factors listed above.

FEATURES

1. Sustained accuracy and stability insured by careful design and the use of the null balance principle.

2. Trouble free service insured by sturdy Electronic Detector which replaces moving parts and delicate instrument suspensions.

3. Comparison of related factors made easy by continuous records of as many as four factors on a single chart.

4. Maintenance simplified by easy access to all parts and by exchangeable unit assemblies.

5. Attractive control panels assured by identical styling of all recording instruments.

6. Panel space saved by installing two controllers in one instrument.

7. Choice of three controls—air, on-off electric, modulated electronic.

8. Easy installation—no careful leveling or protection against vibration.

Ask for Bulletin 231

BAILEY METER COMPANY
1047 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Processing

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTIBLES
FLOW
LEVEL
DENSITY
RATIO

United 21" & 53" x 42" High Speed 4-High, 5-Stand Tandem Cold Strip Mill.
United 45"x80" Slabbing Mill.
United 100" 4-High, 4-Stand Tandem Plate Mill.
United 9½" & 22" x 12"— 4-High Reversing Cold Mill.
United 18" Merchant Mill.
UNITED MILLS
United 20½" & 49" x 54"—4-High Skin Pass Mill.
United 28"— 3-High Bar and Structural Mill.
United 2" & 11" x 4"— 4-High Cold Strip Mill.
United 15" & 30" x 36"— 4-High, 2-Stand Tandem Cold Mill.
United 27" & 53" x 98"— 4-High Hot Strip Mill. (The World's Largest)

PITTSBURGH, PENNSYLVANIA

PLANTS AT PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON

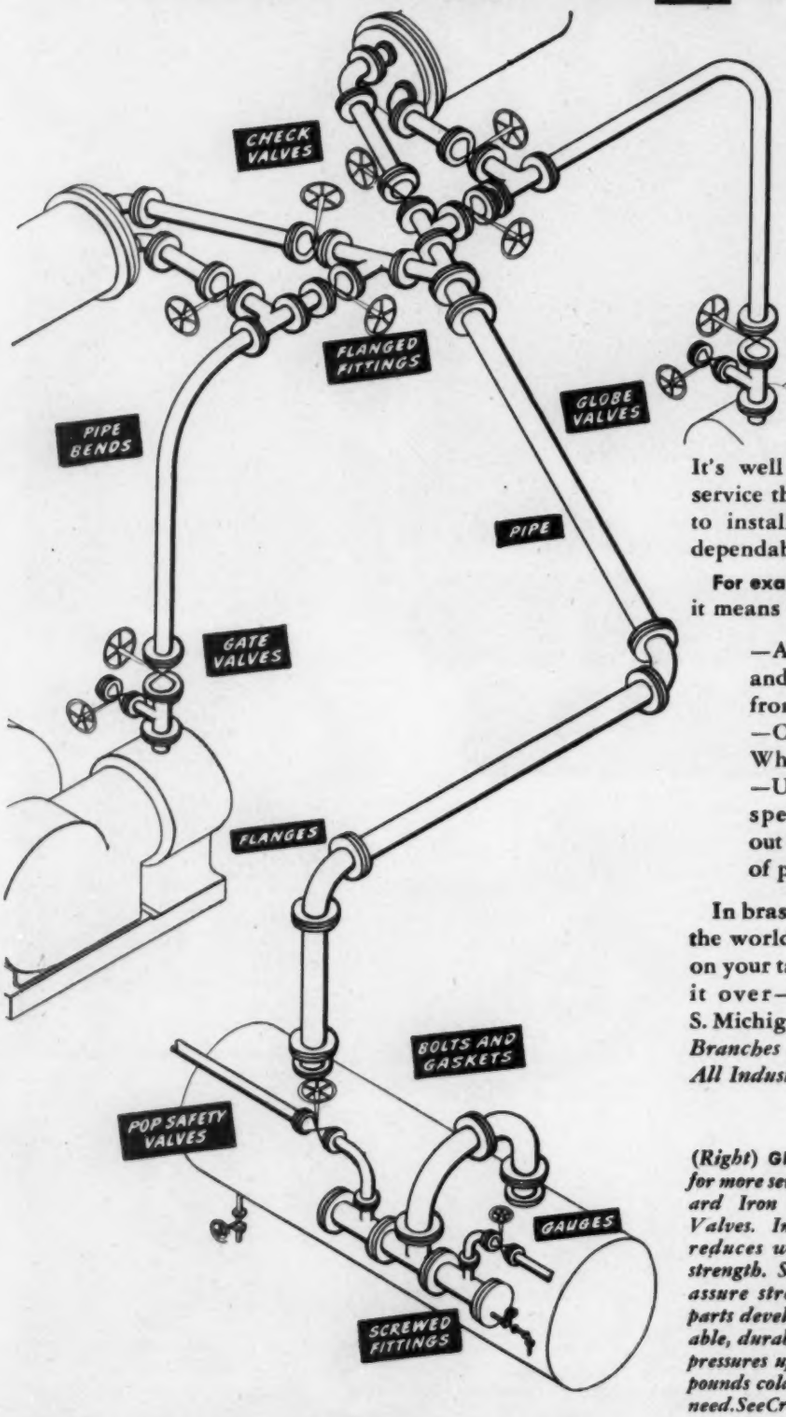
Subsidiary: ADAMSON UNITED COMPANY, AKRON, OHIO

Affiliates: DAVY AND UNITED ENGINEERING COMPANY, LTD., SHEFFIELD, ENGLAND
DOMINION ENGINEERING WORKS, LTD., MONTREAL, P. Q., CANADA

The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment

WORTH REMEMBERING!...

CRANE Supplies all Piping Materials



ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

It's well worth remembering and using now—the service that simplifies all your piping jobs from plan to installation. And the one that assures uniform dependability in every part of piping systems.

For example, on this compressor installation, look what it means to have the Crane line for your partner:

—All valves and fittings, pipe, accessories, and fabricated piping units are specified from a single source.
—One order to your Crane Branch or Wholesaler gets them all.
—Undivided responsibility for materials speeds the job. Crane quality throughout guards against untimely breakdowns of piping, and excessive upkeep.

In brass, iron, and steel equipment, Crane gives you the world's most complete selection. There's no limit on your taking advantage of this Crane service. Think it over—now! CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas.

(*Right*) **GREATER ADAPTABILITY** *for more services—Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight yet increases strength. Straight-through ports assure streamlined flow. All parts developed to give dependable, durable service. For steam pressures up to 125 pounds; 200 pounds cold. Patterns for every need. See Crane Catalog, page 101.*

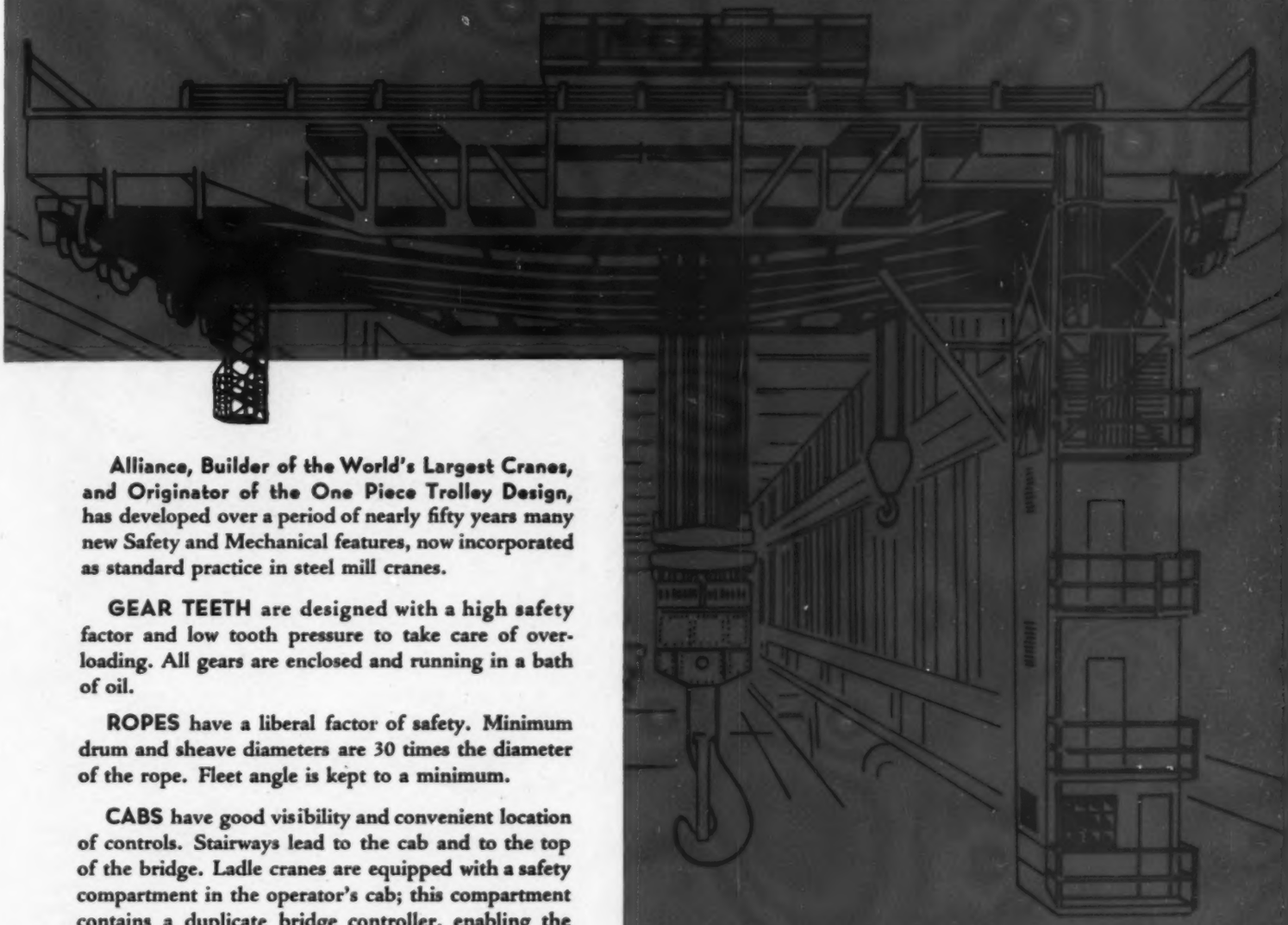
EVERYTHING FROM . . .
VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE

FOR EVERY PIPING SYSTEM

Alliance Builds Cranes

BIGGER and BETTER



Alliance, Builder of the World's Largest Cranes, and Originator of the One Piece Trolley Design, has developed over a period of nearly fifty years many new Safety and Mechanical features, now incorporated as standard practice in steel mill cranes.

GEAR TEETH are designed with a high safety factor and low tooth pressure to take care of overloading. All gears are enclosed and running in a bath of oil.

ROPES have a liberal factor of safety. Minimum drum and sheave diameters are 30 times the diameter of the rope. Fleet angle is kept to a minimum.

CABS have good visibility and convenient location of controls. Stairways lead to the cab and to the top of the bridge. Ladle cranes are equipped with a safety compartment in the operator's cab; this compartment contains a duplicate bridge controller, enabling the operator to move the crane in safety in case of accidental spilling of hot metal.

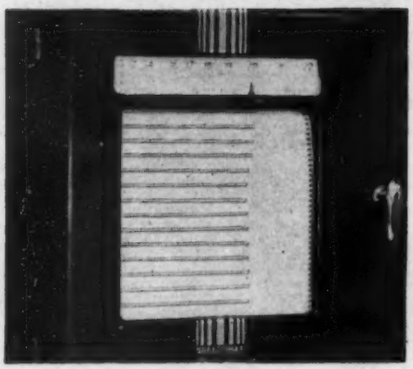
FOUR MAIN HOISTING ROPES, not one, carry the load on Alliance Ladle Cranes. This patented safety rope reeving combined with another Alliance development, (the laminated plate ladle hook), make up a safety team that is the acknowledged *tops* for safe handling of hot metal.

Rely on Alliance for

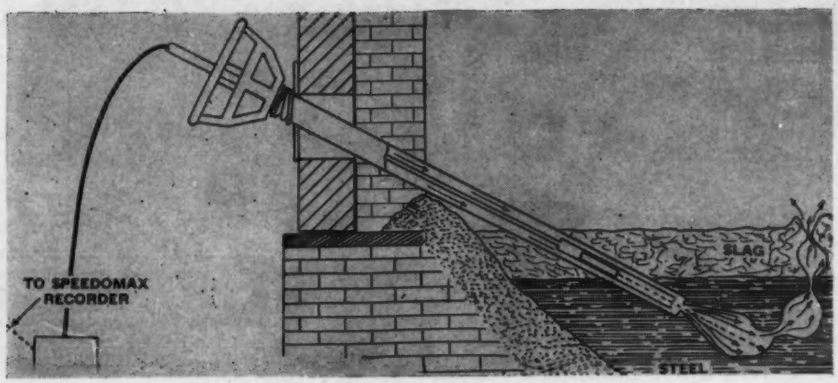
LADLE CRANES · GANTRY CRANES · FORGING MANIPULATORS
SOAKING PIT CRANES · OPEN HEARTH CHARGING MACHINES
STRIPPER CRANES · SLAB AND BILLET CHARGING MACHINES
SPECIAL MILL MACHINERY · STRUCTURAL FABRICATION

THE ALLIANCE MACHINE COMPANY
ALLIANCE, OHIO
1622 OLIVER BLDG. . . PITTSBURGH, PA.

Alliance

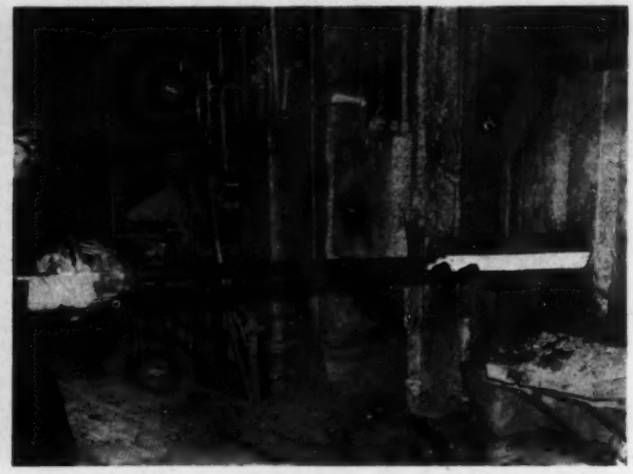


Speedomax instantly records metal temperature detected by Immersion Rayotube.



Immersion Rayotube in operating position, showing Rayotube sighting directly on the hot metal beneath the slag . . . . measures actual temperature of molten metal.

Operator inserts the tube through the wicket hole, plunges end into the bath. A stream of air blows down the tube, keeps it clear of molten metal and slag.



Actual immersion time is only about 5 seconds. Operator withdraws Immersion Unit, scraping off slag on the edge of the wicket hole, and places instrument on the floor to cool.

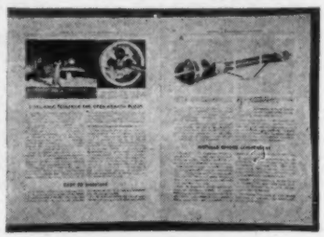
BRAND-NEW INFORMATION

FOR OPEN-HEARTH SHOPS EVERYWHERE

The temperature of open-hearth steel can now be measured repeatedly in the furnace . . . . measured every few minutes, if desired, before tapping instead of afterwards . . . . by means of our new Immersion Rayotube Pyrometer.

Metallurgists are getting brand-new information from these measurements — information which helps tremendously in producing the desired analysis in the melt. And this information of course helps in studying the chemistry and physics of steel making.

Open-Hearth Helpers, supplied with this new information, are hitting the tapping temperatures more exactly "on the nose." Correct temperature into the ladle naturally helps to get correct pouring temperature from ladle to mould. Skulls are fewer and smaller, and may be eliminated; overhot pouring is similarly reduced. Thus both better steel and greater operating efficiency can result.



The Immersion Rayotube Pyrometer is dependable, quick and economical. We'll be glad to send Folder N-33B-643(1), on request.

LEEDS & NORTHRUP COMPANY. 4942 STENTON AVE., PHILA. 44, PA.

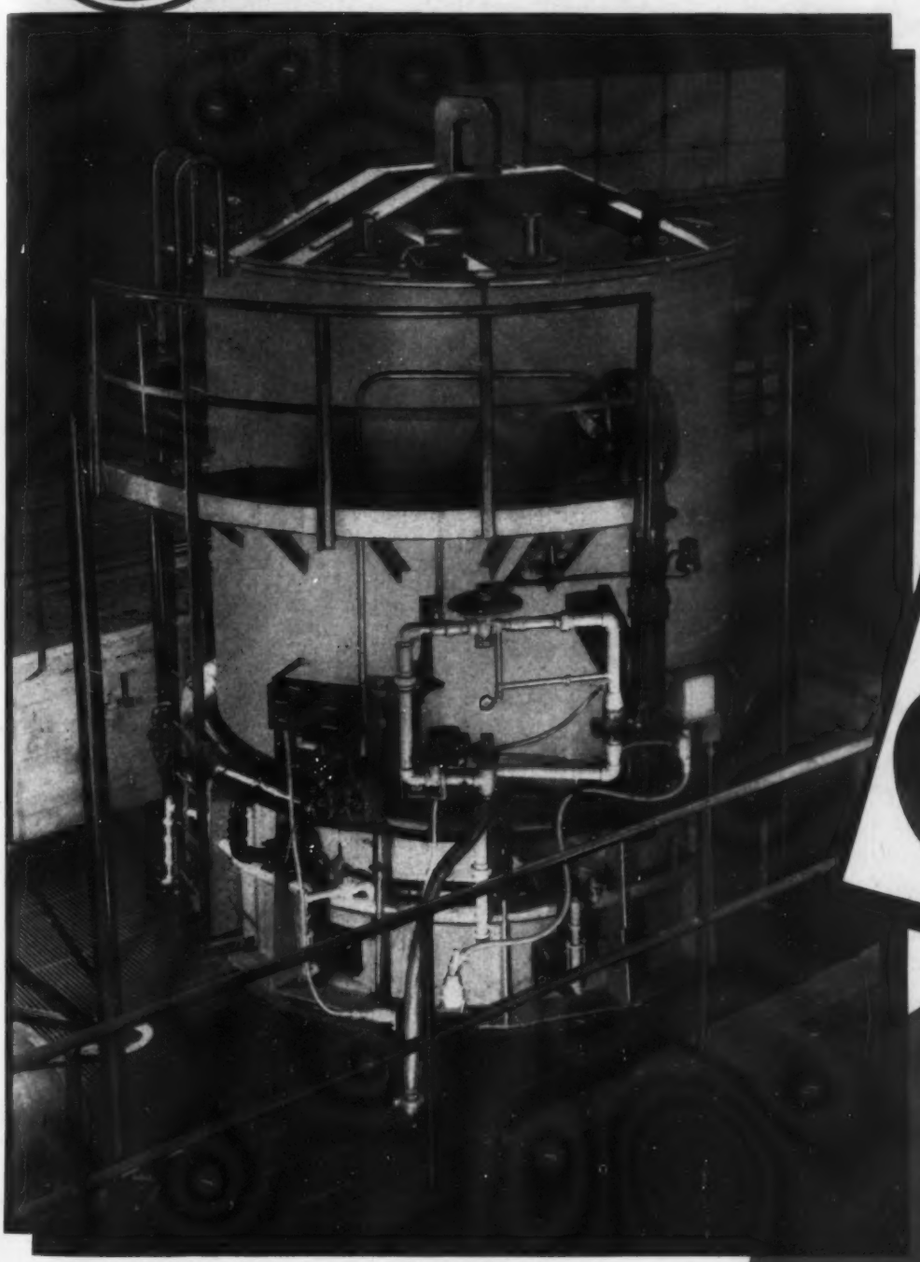
LEEDS & NORTHRUP

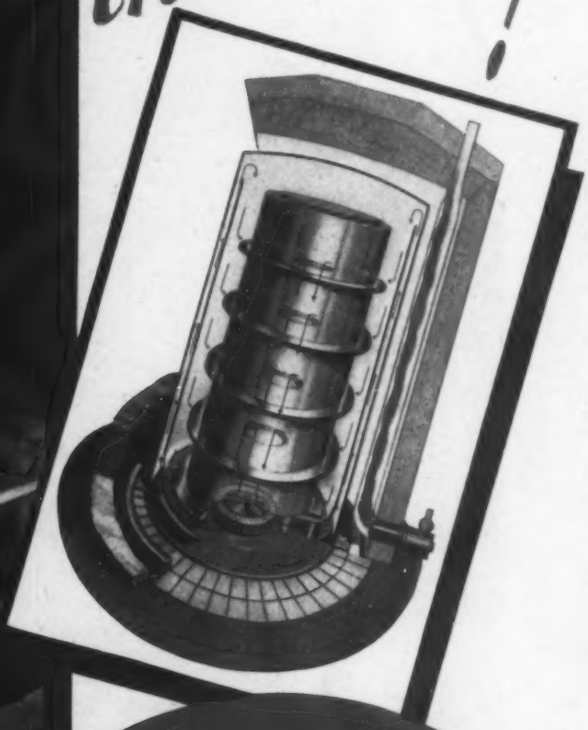
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

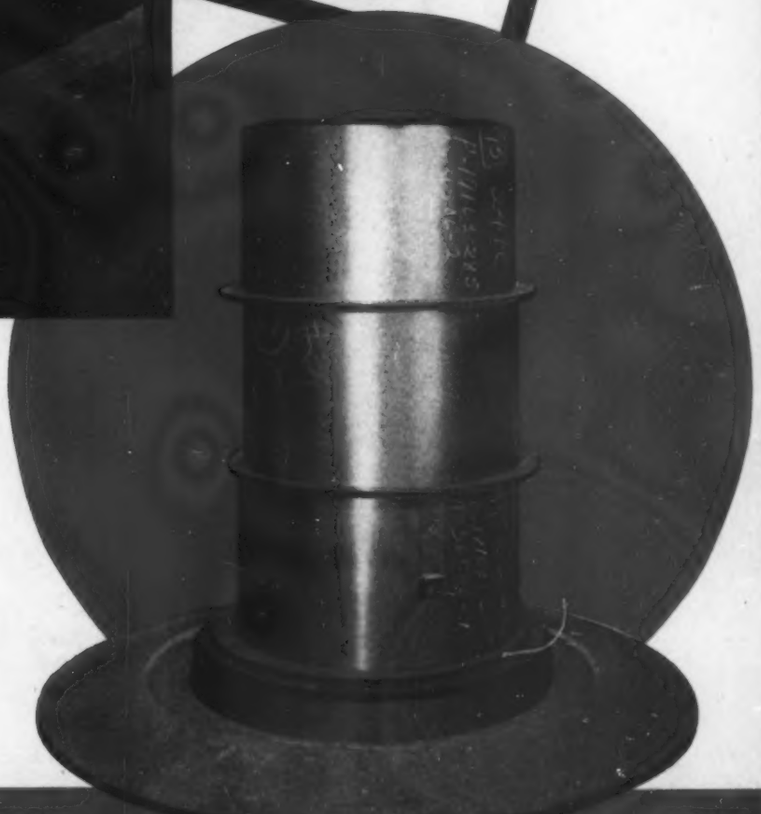
Jrl Ad N-33B-643(5)

The WILSON RADIANT CONVECTOR FURNACE

in Action!







ONE of the pilot installations of the Wilson Radiant Convector Furnace for coils 60" in diameter—piling height 120".

ENGINEERED AND CONSTRUCTED BY THE

Lee Wilson ENGINEERING Co., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

INDUSTRIAL FURNACES • RADIANT TUBE HEATING • HEAT TREATING PROCESSES

Gaging WITHOUT CONTACT

At a Speed as Fast as Light!

Hot sheets or strips of metal or foil flying from the rolls; paper emerging in a never-ending sheet; or the plastic or rubber blanket flowing from a calender, may be checked instantly for thickness, and this thickness controlled during the process by the Sheffield Measuray.

Temperature of the material to be checked and its speed of movement do not affect the accuracy of the thickness check. Proximity of gaging head to material is not important—it can be as much as a foot or more distant, depending upon the application. Amplification and sensitivity are available in excess of any known industrial requirements without sacrifice in speed, range, or dependability. For instance, it is possible to amplify one per cent of the thickness of the stock being checked to extend over the full scale range.

The Measuray may be mounted on a production machine, or it may be used at the bench to measure stationary objects, especially those whose surfaces might be marred by a contact gage, or those of such resiliency that the contact gage measurements are not practicable.

See the Measuray demonstrated at the Sheffield plant in Dayton. Bring samples of work to be checked to see for yourself the savings in material and time, elimination of losses in destructive testing, and the increase in uniform quality which the Sheffield Measuray can bring you.

If a visit is not convenient, write us for detailed information. For an early installation, ask for a survey to be made in your plant by Sheffield engineers—no obligation on your part.

Write to Department F

Real job security is only provided by plentiful incoming orders shipped at prices consumers can afford and want to pay . . . modern machine tools help make this possible.

METAL CONGRESS BOOTH H-234

2307

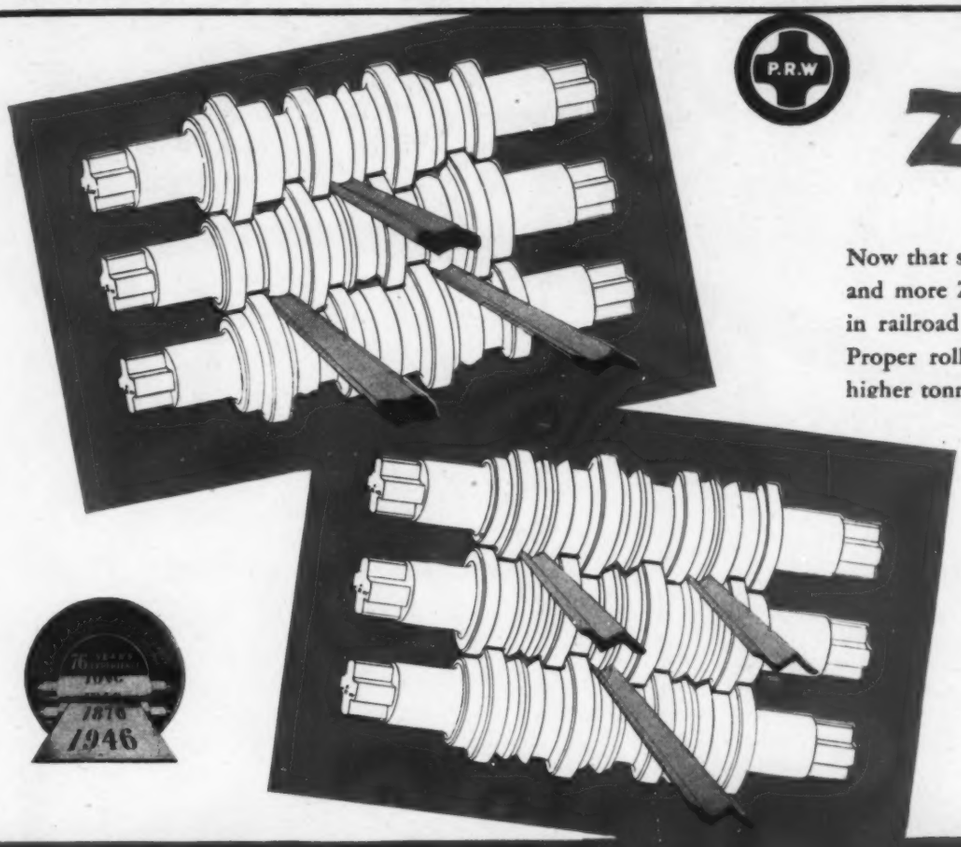
THE SHEFFIELD CORPORATION

Dayton 1, Ohio, U.S.A.

MACHINE TOOLS • GAGES • MEASURING INSTRUMENTS • CONTRACT SERVICES

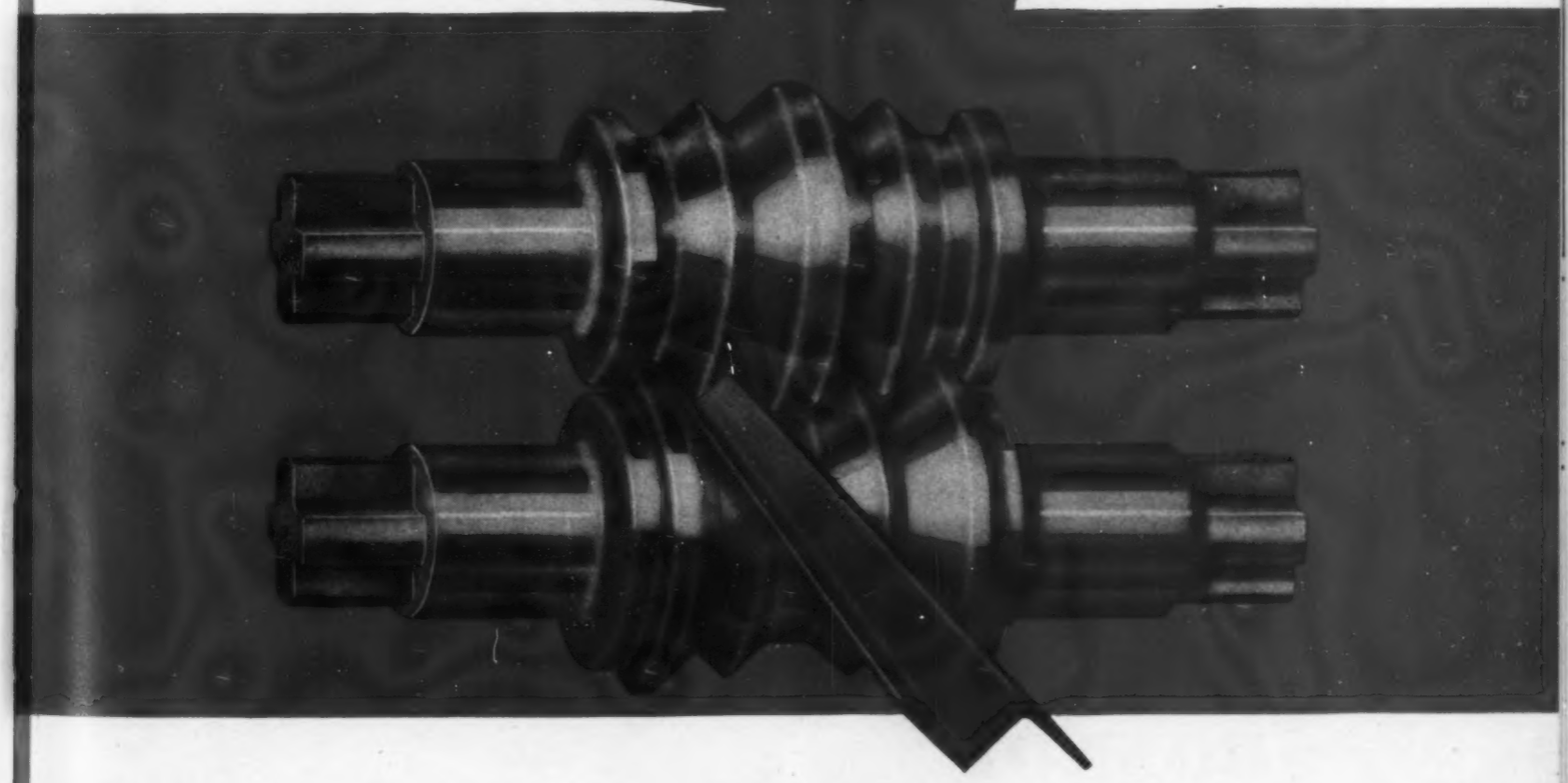
ROLLING TECHNIQUE . . .

Z BAR



Now that steel is back in civilian use, more and more Z Bars will be rolled to be used in railroad cars, building construction, etc. Proper rolls will help greatly in obtaining higher tonnages with fewer roll changes and result in better quality steel being rolled.

Pittsburgh Rolls, with over three-quarters of a century of roll-making experience behind them, can be relied upon to deliver the production of highest quality for which high speed modern mills are designed, at *less cost per ton of steel rolled.*



PITTSBURGH ROLLS Division of Blaw-Knox Company PITTSBURGH, PA.

PITTSBURGH ROLLS

the BILLETEER cuts conditioning costs 4 ways

$ LOWER LABOR COSTS

One semi-skilled operator, using a Billeteer, can do the work of ten hand chippers —radically reducing labor cost and releasing man-power for less-killing, actually-productive work.

$ SUSTAINED EFFICIENCY

Operation of the Billeteer imposes no strains on the worker. Quality and quantity of output never suffer from fatigue, grogginess, jitters, illness or "off" days.

$ VALUABLE SCRAP RECOVERY

The Billeteer does not "burn up" hard-to-get scrap. Every chip can be saved . . . clean . . . classified according to analysis . . . ready for the charging box. In some mills, each Billeteer saves as much as 1½ tons of scrap a day.

$ BILLET SALVAGE

Because of the low operating cost, the Billeteer can be used to salvage billets so badly seamed that it would be impractical to attempt to save them without the Billeteer.

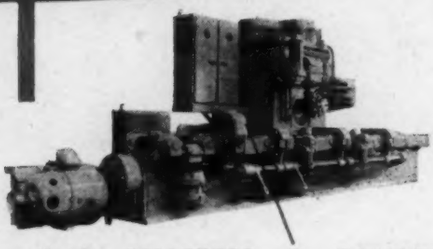
LET US SHOW YOU how much the Billeteer can save in your Billetshed operations.

Engineered

FOR LOWER OPERATING COSTS

BONNOT

THE BONNOT COMPANY • builders of the BILLETEER • CANTON 2, OHIO

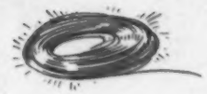


• Bonnot Billet Inspection Tables • Charging Tables • Cold Saws Grinding Pans • Clay Mixers • Clay Feeders, Etc. •

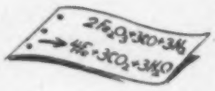
WHEN

THEN

THE JOB IS BRIGHT ANNEALING LOW-CARBON WIRE

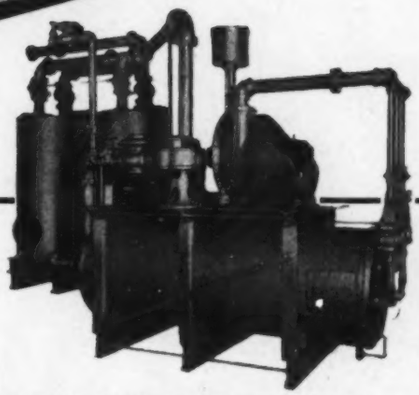


REDUCING VARIOUS METALLIC OXIDE POWDERS



TREATING SPRING STEEL IN DRY NON-DECARBURIZING GAS

KEMP "atmos-gas" fits



AT ONE OF OHIO'S LARGEST STEEL MILLS

. . . this KEMP "atmos-gas" producer guards low-carbon steel from the effects of both oxygen and water vapor—throughout a full 72-hr. bright-annealing cycle. It supplies enough protective atmosphere (15,000 cu. ft. per hr.) to keep up with 15 or 20 sheet-annealing bases. Operating at 6:1 air-gas ratio, and equipped with generous silica gel desiccating towers (left rear), it produces the analysis: N_2—72%, CO_2—5.8%, H_2—12.1%, CO—9.8%, CH_4—0.2%, O_2—none—dried to a dew point of—40°F.

And the reason is clear-cut. KEMP "atmos-gas" units are designed to suit the particular requirements of the particular process.

For example, high-carbon steels are touchy. Too much CO_2 or too much water vapor may cause decarb or scaling during the annealing cycle. In such cases, KEMP "atmos-gas" units incorporate amine scrubbers for CO_2 absorption, and silica-gel towers to desiccate the output.

For treating copper and brass, "atmos-gas" in the low CO range is preferred. The reduction of metallic powders requires quite the opposite.

Where fuel-gas might be "sour", copper gauze strips sulfur from the atmosphere gas.

It all depends on *your* products and *your* processes. KEMP engineers can tell you where you stand in the confusion of claim and counterclaim in this fast-developing business of atmosphere heat treating.

KEMP OF BALTIMORE

PRECISION CARBURETION + ADAPTED COMBUSTION FOR INDUSTRY'S HEAT-USING PROCESSES
ATMOSPHERE GENERATION & ADSORPTIVE DRYER SYSTEMS FOR PROCESS CONTROL AND PROTECTION

JMLee K-Klis

The C. M. Kemp Mfg. Co.
405 E. Oliver Street, Baltimore 2, Md.

Put me on your mailing list for that new engineering literature you are working up ☐
I'll write and state my problem, so that you can talk my specific case when you reply ☐
Send your nearest field-engineer to see me ☐

NAME_____
POSITION_____
COMPANY_____
PLACE_____

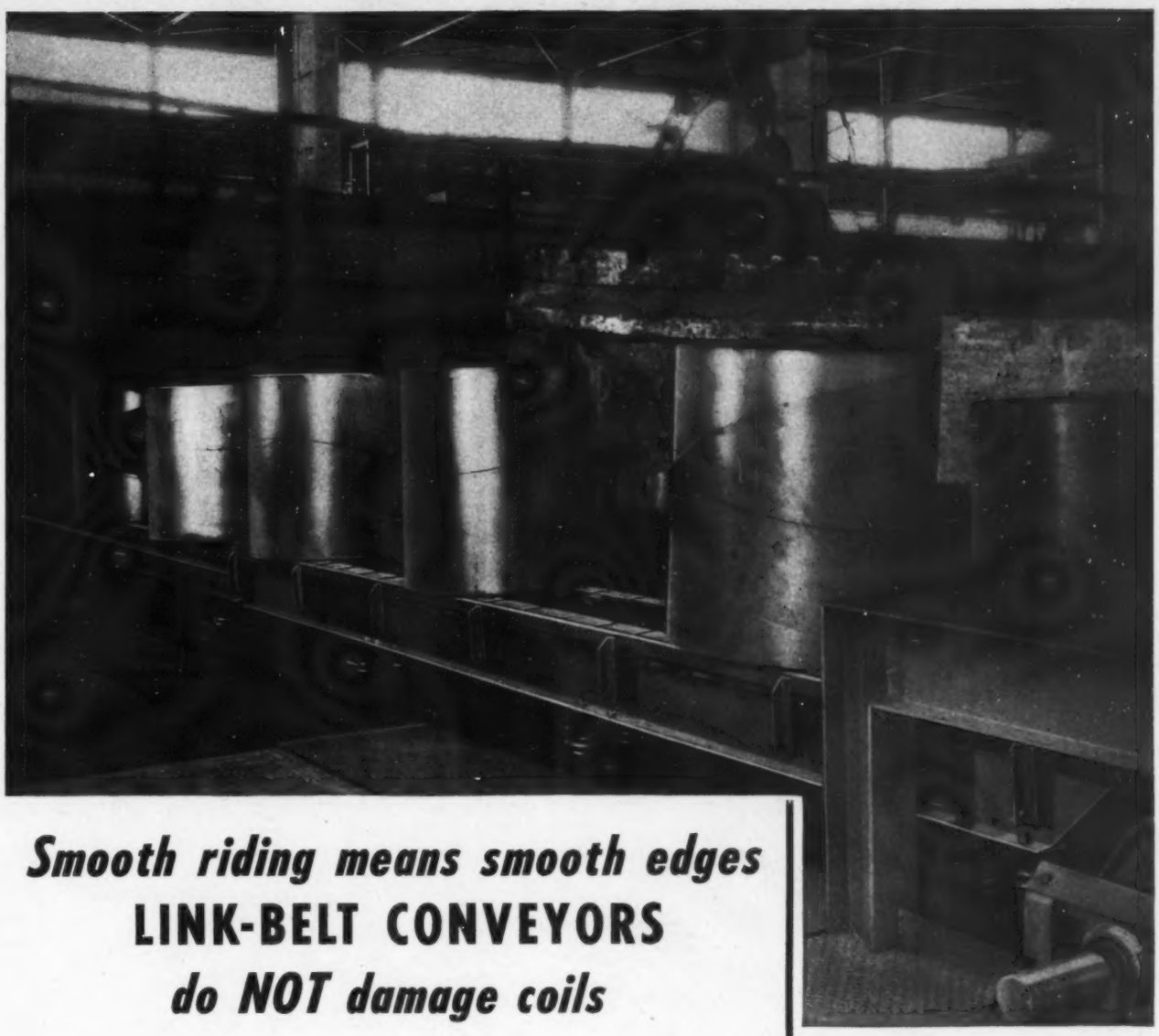
"Maybe we shoulda got a Fluor Cooling Tower* after all."

The surest way to satisfaction is to specify FLUOR *Cooling Towers to begin with. You're always sure with* FLUOR.

THE **FLUOR** CORPORATION, LTD., 2500 South Atlantic Boulevard, Los Angeles 22, Calif.

NEW YORK • PITTSBURGH • KANSAS CITY • HOUSTON • TULSA • BOSTON

ENGINEERS • MANUFACTURERS • CONSTRUCTORS



Smooth riding means smooth edges
LINK-BELT CONVEYORS
do NOT damage coils

The trend toward mill modernization is a program of cost reduction in steel production. But mechanization, in itself is not enough. Mechanization must be as completely useful as possible if it is to serve its purpose in cost reduction.

Link-Belt Coil Conveyors offer such efficient mechanization. It is not enough to move coils. Coils must be moved *safely* . . . they must be transferred without damage. Movement that scuffs edges . . . that wastes steel . . . is far from effective mechanization.

Link-Belt Coil Conveyors protect as well as transport. Ample bearing surfaces, rugged and rigid construction move coils gently, carefully, safely. Available in designs for handling coils in various positions.

A Link-Belt Engineer will be pleased to discuss your problems.

SERVICE *to* STEEL *by* LINK-BELT

Complete line of Chains for transfer tables, coil conveyors, furnace conveyors, feeder and catcher tables, sheet pilers, draw bench and other equipment . . . Elevators and Conveyors of all types . . . Vibrating Screens . . . Dryers and Coolers . . . Skip Hoists . . . Car Dumpers . . . Water-Intake Screens . . . Silent and Roller Chain Drives . . . Speed Reducers and Increasers . . . Variable Speed Transmissions . . . Babbitted, Ball and Roller Bearings, etc.

LINK-BELT COMPANY

Chicago 9, Pittsburgh 19, Cleveland 13, Detroit 4, Indianapolis 6, St. Louis 1, Kansas City 6, Mo., Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

10,263

LINK-BELT CONVEYORS

PREPARATION EQUIPMENT . . . POWER TRANSMISSION MACHINERY

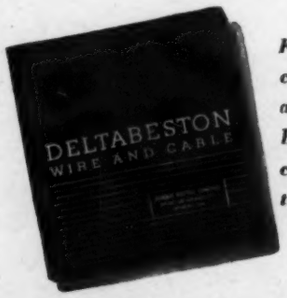
DELTABESTON*

Beats 'em All!

If there's a hot spot in your plant that threatens the power supply, Deltabeston can help you play safe. The unusual conditions met in steam tunnels, boiler rooms, steel plants, central stations . . . at furnaces, ladles, and soaking pits are tough on ordinary wire and cable. General Electric builds its Deltabeston cable to meet — and beat — these hazards.

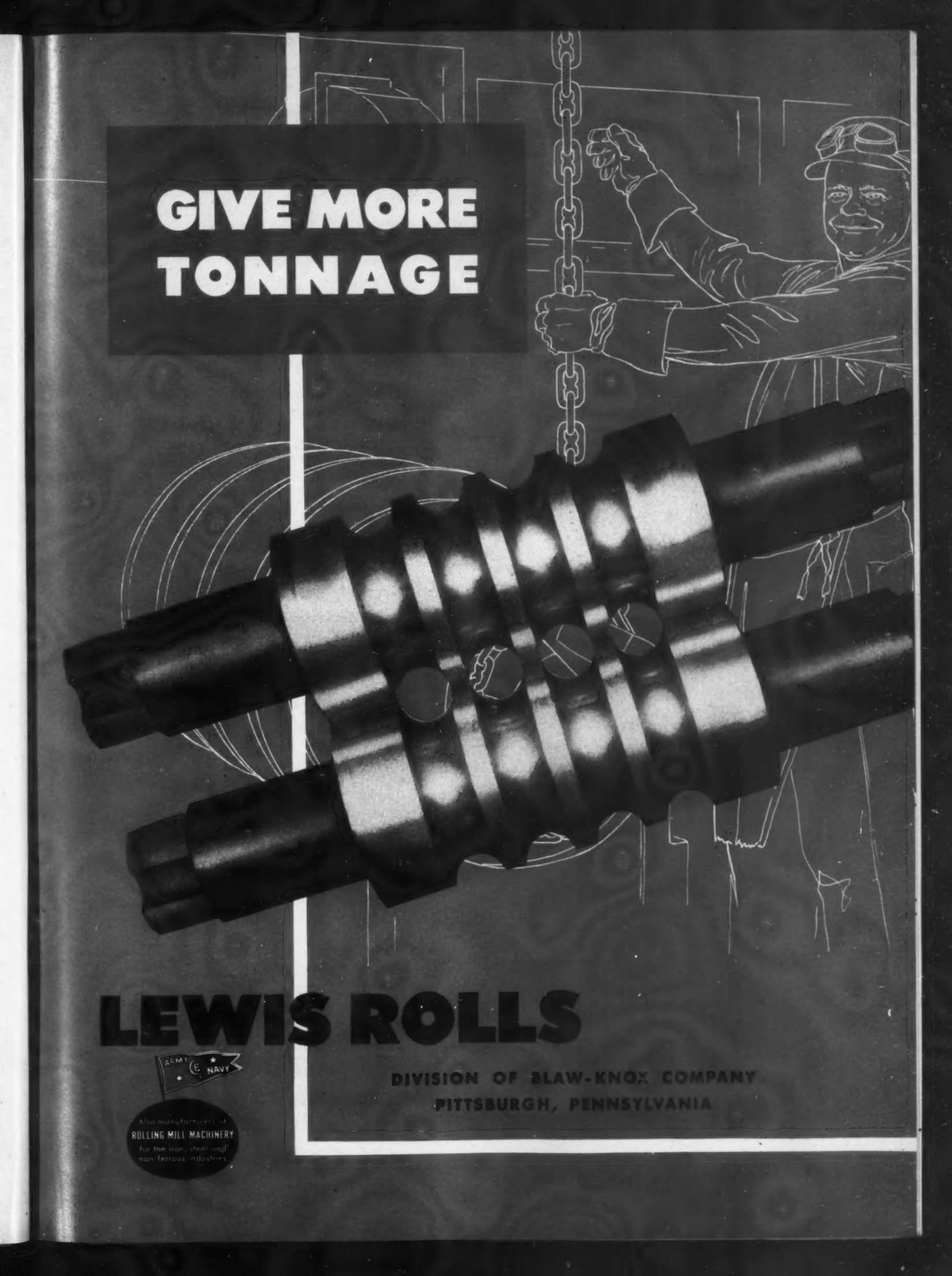
There's a Deltabeston cable to protect against high ambient temperatures, another to take sudden temperature rises, many combinations in design and construction to maintain the safety factor you want. Or you may need a special cable, like the one illustrated, to meet an unusual set of conditions. This is one of many cables developed by General Electric engineers who are specialists in this field. They are ready to help in solving your wire and cable problems.

**Trade-mark Reg. U. S. Pat. Off.*



For a copy of the complete Deltabeston catalog, write Section Y15-1031, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut. Deltabeston Wires and Cables are distributed by G-E Merchandise Distributors.

GENERAL ELECTRIC


GIVE MORE
TONNAGE
LEWIS ROLLS
ARMY E NAVY
Also manufacturers of
ROLLING MILL MACHINERY
for the iron, steel and
non-ferrous industries
DIVISION OF BLAW-KNOX COMPANY
PITTSBURGH, PENNSYLVANIA

New No. 10-W Youngstown Limit Stop *for* Improved Protection against Overtravel

No. 10-W Youngstown size; 40 H.P., 230 volts; d.c. maximum rating.

Now, a **weight-operated** Safety Limit Stop for the smaller horsepower crane-hoists. Tripped by **weighted** operating-lever when the danger zone is reached . . . reset **automatically** by suspended **weight** when controller is reversed to lower the hook-block. Other advantages are:

1 No lubrication required—Oilite bearings are self-lubricating and long-lived. This means that the costly and sometimes forgotten item of lubrication-maintenance is eliminated forever.

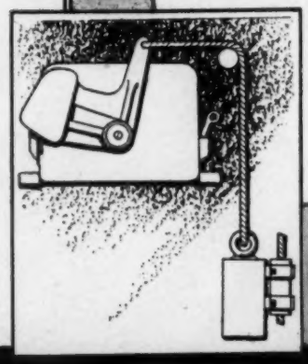
2 Compact—easy to mount—Small, over-all dimensions—four convenient mounting holes —one suspended weight.

3 Small reset travel—High crane lifts are possible with this new No. 10-W because the amount of travel between "run" and "tripped" positions has been kept at a minimum.

4 High interrupting capacity—Two normally open and two normally closed contacts, mechanically interlocked and with wide, vertical opening, always assure positive interruption of the hoist motor current.

● No. 20 size for motors up to 100 H. P.; 230 volts direct current.

● **Also No. 30** for ratings beyond the above, providing a complete line of weight - operated Limit Stops with single suspended weight for crane hoists.



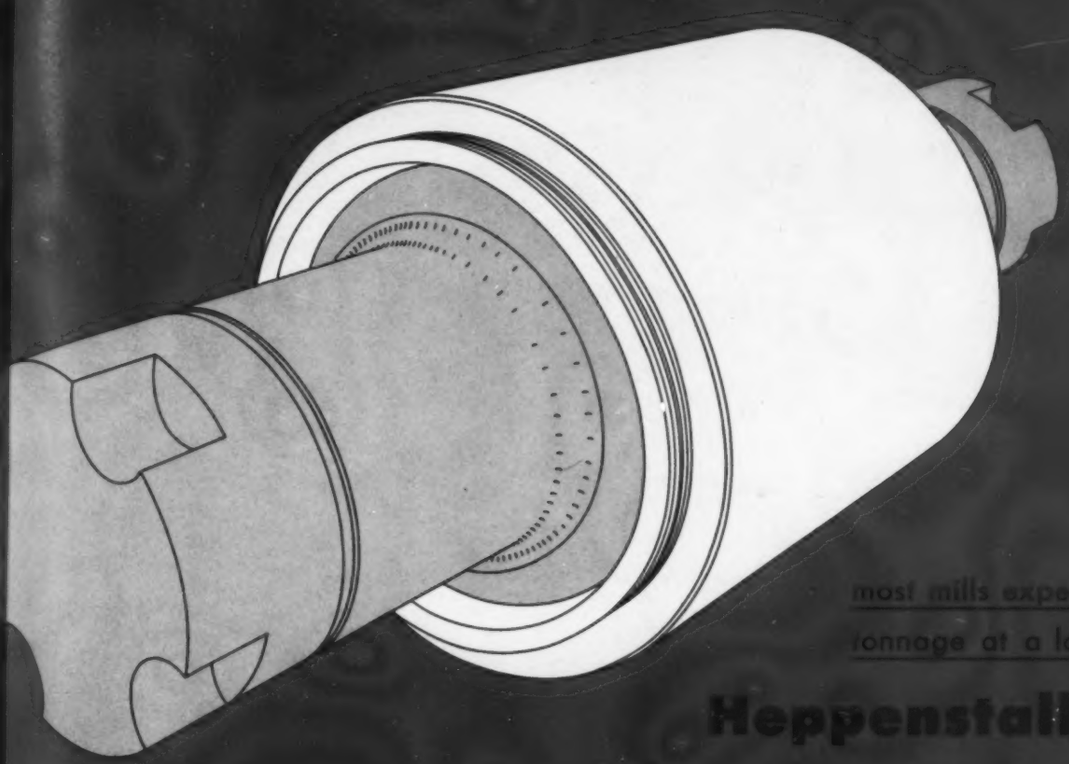
Send for Bulletin 1032 which gives complete details for applying Youngstown Safety Limit Stops to both new and old cranes, either a.c. or d.c.

Optional Style—with offset weighted-arm which eliminates intermediate sheaves when Stop is not mounted directly over crane hook-block. Available on all sizes of EC&M Youngstown Limit Stops.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79th STREET ★ CLEVELAND 4, OHIO

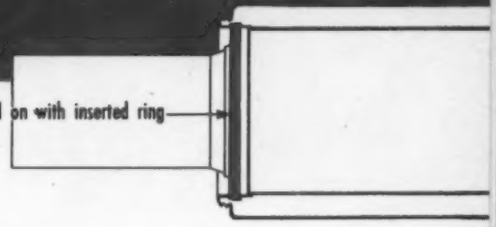
There's a sound reason why



most mills expect and get greater tonnage at a lower cost with . . .

Heppenstall Sleeves

for back-up rolls

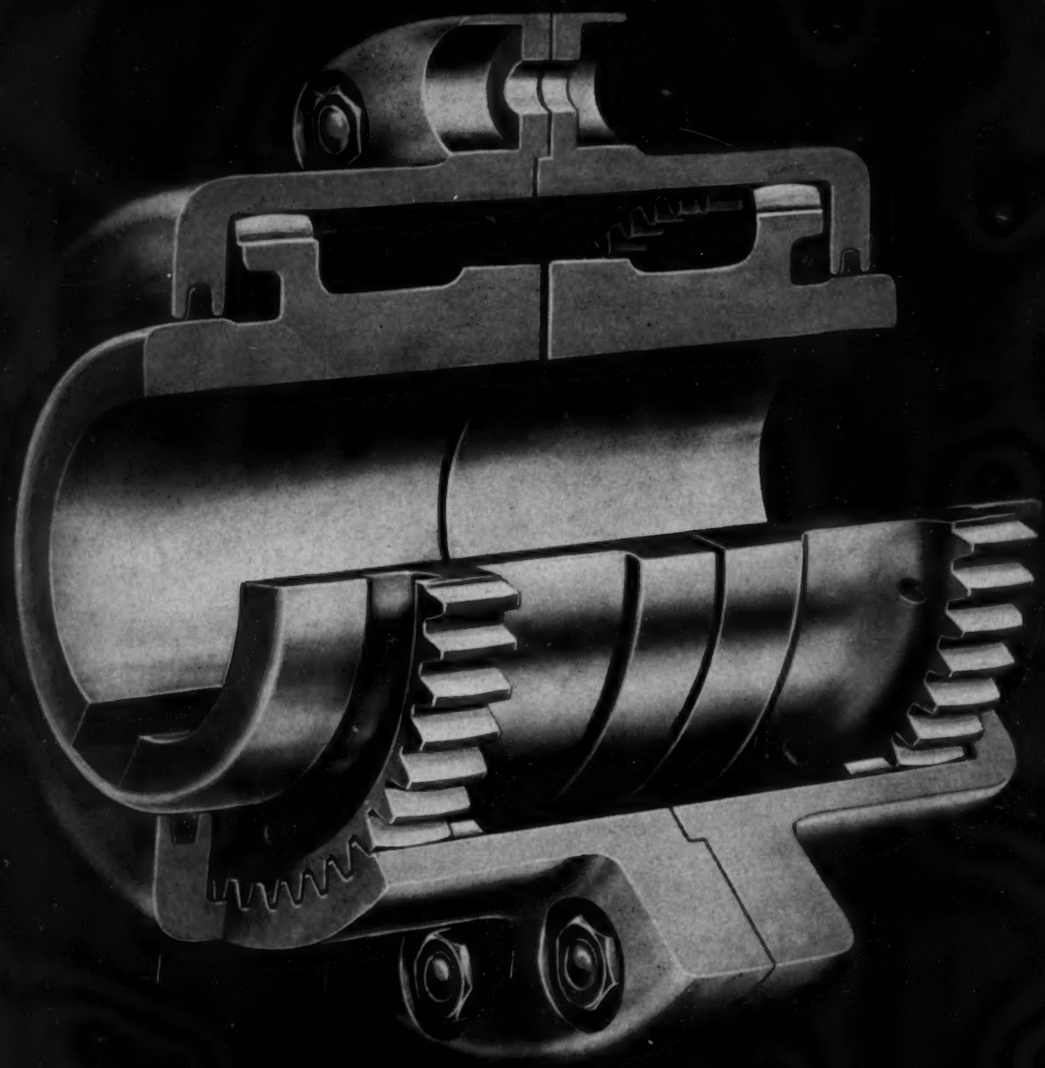


Heppenstall back-up roll sleeves have 3 important, proved advantages over a solid roll: (1) They last much longer; (2) They cost less; (3) They eliminate the expense of scrapping a worn roll . . . Being a relatively small mass of metal with no necessity for the usual compromise between strength of necks and hardness of surface, these sleeves permit the incorporation of all Heppenstall's skill in metallurgy, forging and heat treating . . . and they can be furnished in any workable degree of hardness desired. Write for the complete story. Address Heppenstall Co., Pittsburgh, Pa.

Heppenstall

the most dependable name in forgings

POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

How Long will a CARBON CINDER NOTCH LINER Last?

IF INSTALLED properly, there is no reason why a cinder notch liner made of "National" carbon should not last for *many years!* Why?

Because "National" carbon is totally unaffected by corrosive slag attack or by thermal shock. And because, being made of only two pieces, the carbon liner has only two joints! (This feature also makes the carbon cinder notch quick and easy to install.)

Send for more details! Engineers at National Carbon are ready to assist in the design of a carbon cinder notch for your particular furnaces. Write to Dept. IS.

• • •

Entirely unaffected by corrosive slags.
Unharmed by thermal shock.
Easy to install—fewer joints.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation
The word "National" is a registered trade-mark of National Carbon Company, Inc.

UCC

30 East 42nd Street, New York 17, N. Y.
Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

Troubled with Balky Arc Furnace Electrodes?

Fast-Acting, Accurate "Regulex" Control Eliminates Six Furnace "Bugs" Due to Faulty Electrode Action

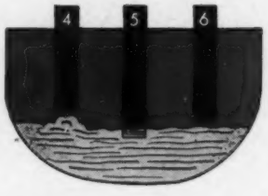
MELTDOWN PERIOD

1. **REPEATED ARC INTERRUPTION,** due to sudden "settling" of metal. Sensitive "Regulex" generators continually adjust electrode position to meet rapidly changing furnace conditions—thus reduce number of arc restrikes required.

2. **INSTABILITY OF ARC,** due to inaccuracy of control for raising an electrode when a short circuit occurs. "Regulex" variable voltage control raises electrodes *just the right amount*—keeps arc values constant and increases furnace output per kilowatt-hour input.

3. **BREAKAGE OF ELECTRODES,** caused by caving in of metal charge against electrodes. Fast-acting "Regulex" control pulls electrodes safely out of a cave-in. "Regulex" generators also limit mechanical shock to electrodes, by reducing time required to strike a steady arc.

REFINING PERIOD



4. **WASTE OF POWER,** as a result of current surges when metal boils up against electrodes. "Regulex" variable voltage control chops off current peaks . . . lower total power input results.

5. **FREEZING OF ELECTRODES** in molten bath, due to electrode "drift" when a-c power fails. Only the "Regulex" generator set is provided with a flywheel for automatically raising electrodes upon a power failure...prevents electrode breakage.

6. **BURNING OF ELECTRODES** during refining period, due to using too short an arc. Accurate "Regulex" control permits use of longer arc—saves electrodes.

Your arc furnace manufacturer will be glad to tell you about "Regulex" furnace control. Or write directly to ALLIS-CHALMERS, MILWAUKEE 1, WIS.

Save Money with "Regulex" Arc Furnace Control!

EXTRA MELTS
"Regulex" variable voltage control means accurate and rapid adjustments in electrode position. Result is that a stable arc is struck in less time. Often, one or more additional furnace melts are obtained per day.

LESS POWER WASTE
"Regulex" generators, with their instant response to changing furnace conditions, help eliminate wasteful current peaks . . . give you maximum arc furnace output with minimum kilowatt-hour input.

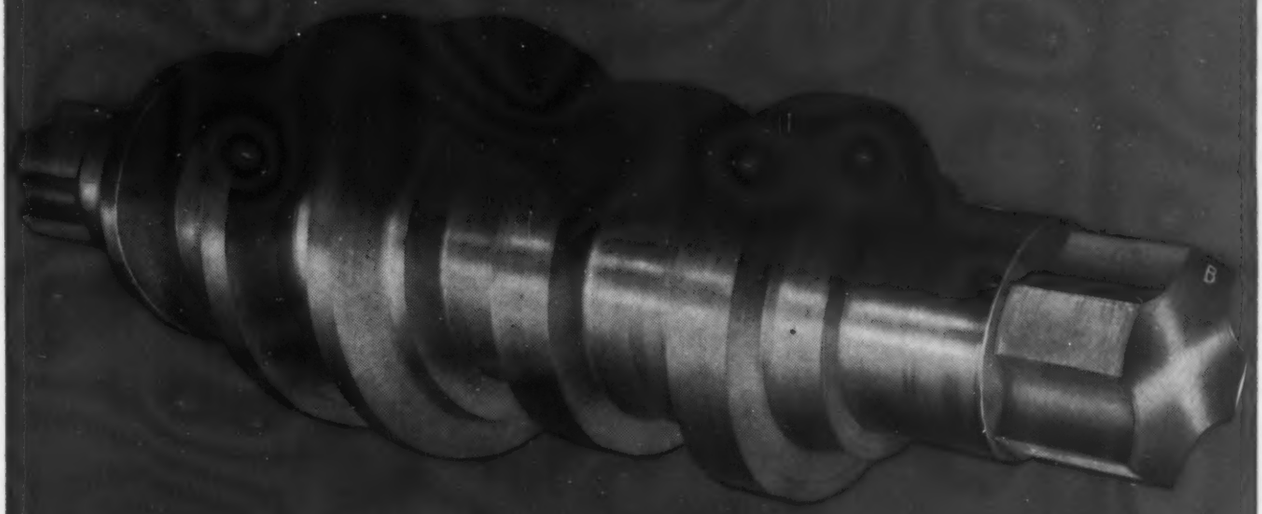
LONGER ELECTRODE LIFE
Fewer arc restrikes, less danger from cave-ins, plus the flywheel feature of the "Regulex" set which prevents "freezing" of electrodes—all these factors add to the life expectancy of your furnace electrodes!

Allis-Chalmers

MILWAUKEE 1, WIS.

A 1940

Where STRENGTH is the Prime Requirement



BIRDSBORO

30

ROLLS

Birdsboro 30 Rolls are the strongest and toughest of Alloy Steel Rolls used for blooming, cogging and roughing—Aircraft Quality Steel (High Percentage Alloy Type)-Stainless Steel (High Percentage Alloy Type)-High Speed Steel—and all rollable steel that is very difficult to reduce because of density.

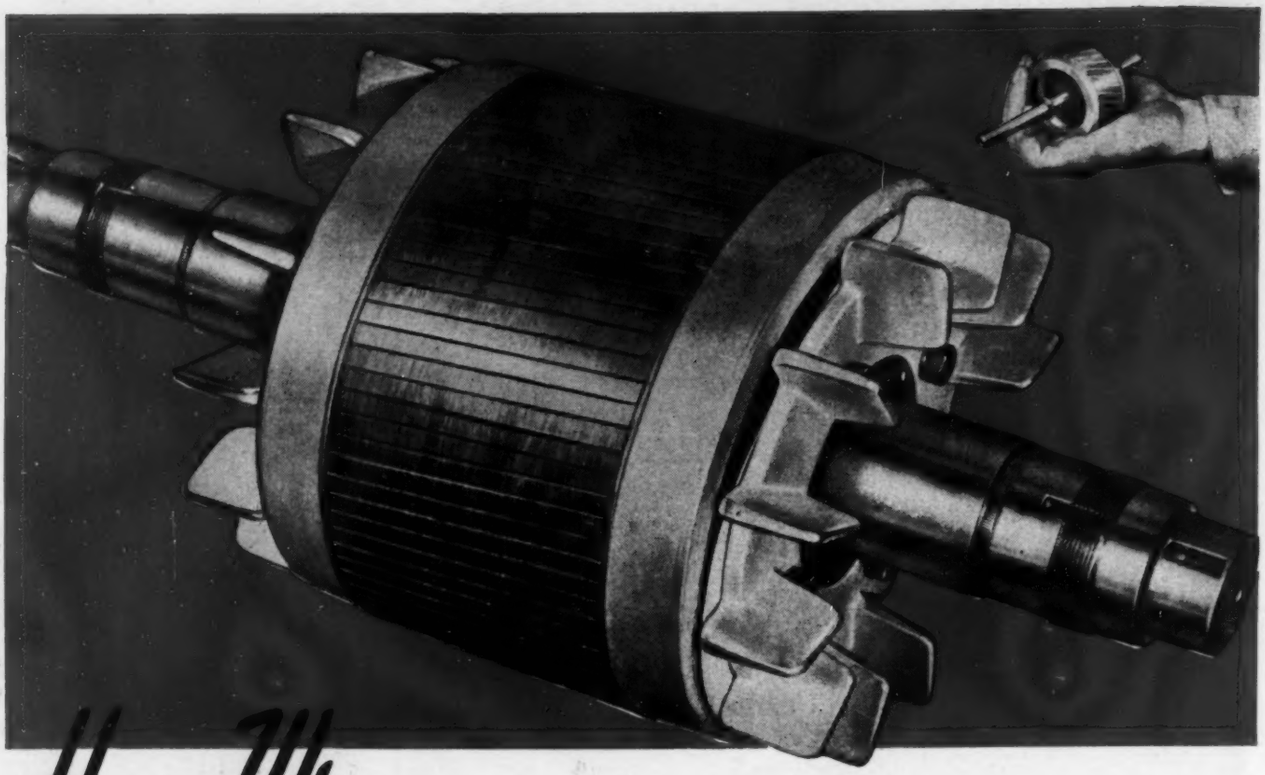
Consult our Roll Engineers if you are experiencing difficulty with Rolling Ingots and Billets of the above steels.

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

Manufacturers of Steel Mill Equipment, Iron and Steel Rolls, Hydraulic Presses, Crushing Machinery, and Special Machinery

BIRDSBORO

ROLLS

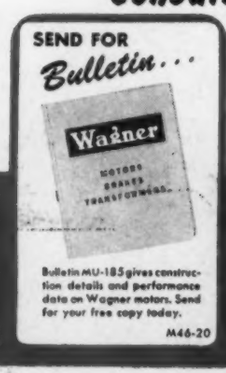


Here's Why Wagner Uses Cast Aluminum Construction Exclusively for the Squirrel-Cages of General Purpose Motors . . .

1. Aluminum, cast under heavy pressure, completely fills the rotor slots and tightly clamps the punchings.
2. The rotor bars and endrings make complete and intimate contact with the core-iron, facilitating heat transfer and absolutely eliminating squirrel-cage vibration.
3. The squirrel-cages, made of practically pure aluminum, have high conductivity and ductility. They successfully withstand the most severe service because they are not affected by repeated heating and cooling and they cannot vibrate.
4. A special patented construction used in the medium and larger sizes of cast aluminum rotors reduces load losses and increases motor efficiency.
5. Hundreds of thousands of Wagner motors have been built with cast aluminum rotors during the past 25 years and are giving perfect satisfaction.

The mechanical and electrical characteristics inherent in cast aluminum rotors have contributed in a large measure to the reputation for quality and dependability established by Wagner motors. Write for complete literature, addressing your request to Wagner Electric Corporation, 6483 Plymouth Avenue, St. Louis 14, Missouri.

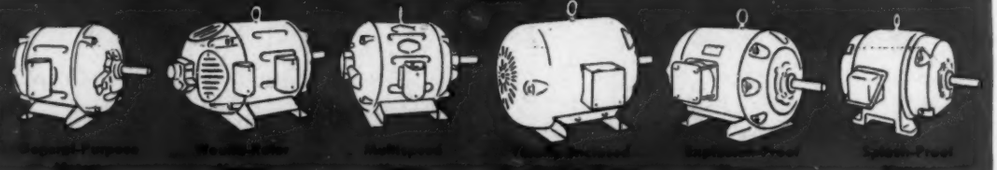
Consult Wagner Engineers on all Electric Motor Problems


SEND FOR
Bulletin . . .
Wagner
Bulletin MU-185 gives construction details and performance data on Wagner motors. Send for your free copy today.
M46-20

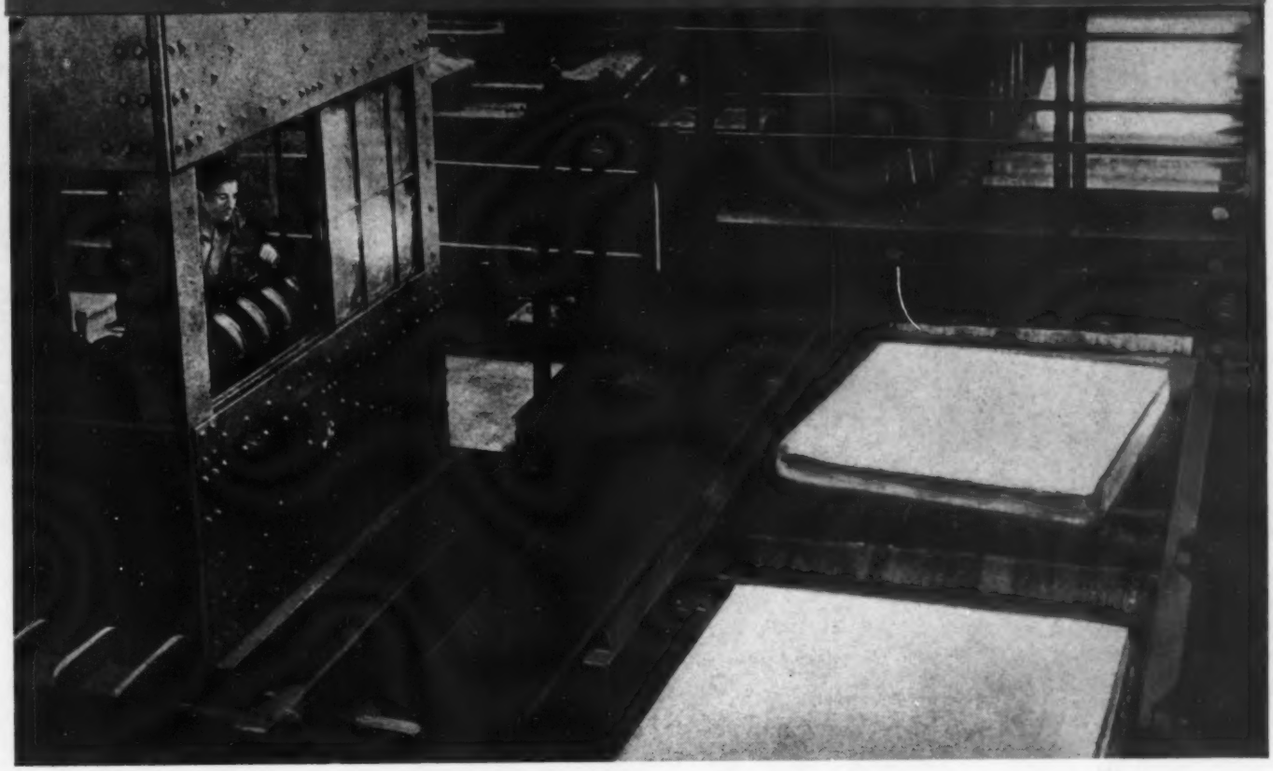
LOCKHEED HYDRAULIC BRAKE PARTS and FLUID . . . NoRol . . . CoMaX BRAKE LINING

AIR BRAKES . . . TACHOGRAPHS . . . INDUSTRIAL BRAKES . . . ELECTRIC MOTORS . . . TRANSFORMERS

Wagner WE Electric



EXTRA PROTECTION
For Your Gear Drives



TEXACO Meropa Lubricants provide *extra* protection against wear for your heavy-duty gear drives and bearings because their load-carrying capacity is higher than any shock loads and pressures normally encountered — even in the heaviest service.

Texaco Meropa Lubricants are more effective, too, because — as proved in actual service — they have exceptionally high resistance to oxidation and thickening. They are non-corrosive, and will not separate — either in use or in storage.

There is a complete line of *Texaco Meropa Lubricants* to meet the requirements of every type of reduction gear drive. *Meropa Lubricants* are equally effective for coiler, edger roll, slab shear and run-out drives, table manipulator gears, and all other parts where extreme-pressure lubricants are essential.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

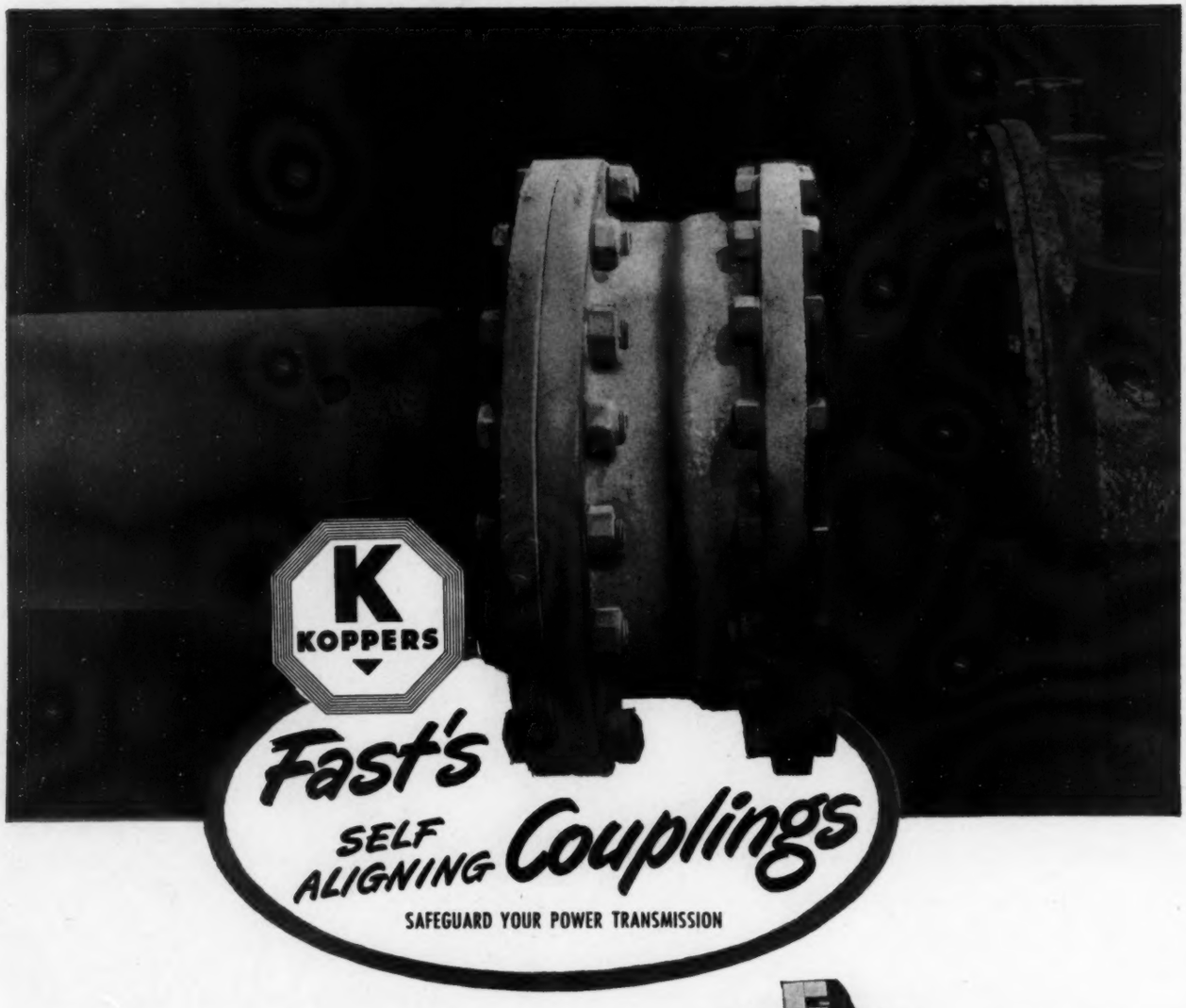
REG. T.M.

TEXACO Meropa Lubricants

FOR STEEL MILL REDUCTION GEARS

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT — CBS

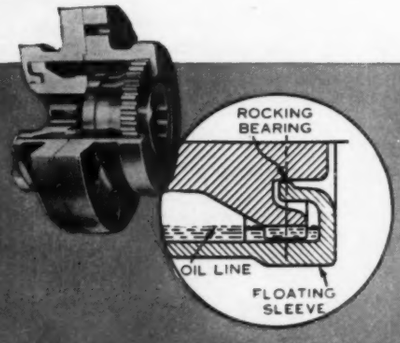
18 YEARS on a Hot Strip Mill Stand with no delays . . . no expense



If this Fast's Coupling shows some scars of toil and time, it's easy to understand . . . for it is rounding out 18 years of continuous service on a hot strip mill. Except for periods when the mill was inactive for reasons of maintenance, holidays, or general shut-downs, operation has been "around the clock." There is no record that the coupling has ever cost anything for maintenance, or caused any interruptions to service.

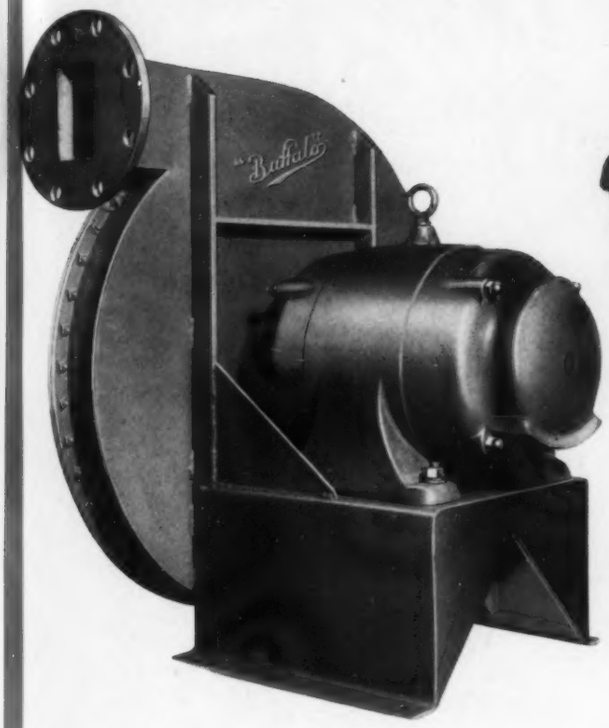
Engineers who have had a chance to observe Fast's Couplings in mill applications won't be surprised at this record, for Fast's Couplings have an earned reputation for long, trouble-free service on the toughest assignments. Many users have reported that they expect their Fast's Couplings to last as long as the connected machines.

When you're looking for dependable couplings, the record of "Fast's" is your best and safest guide. Ask for a catalog. Koppers Company, Inc., 200 Scott St., Baltimore 3, Md.



Here you see the features that give Fast's Couplings their remarkable dependability. All parts are protected from wear by a positive film of oil. Oil purity is guarded by rocking bearings, located in the one position where they maintain a positive metal-to-metal seal. There are no perishable parts in "Fast's."

4 LBS AIR PRESSURE IN A SINGLE STAGE!



—AND THESE "Buffalo" BLOWERS Save You Money

It's truly a milestone in high pressure blowing . . . . bringing you up to four pounds per square inch without requiring added stages. These "Buffalo" Centrifugal Compressors feature vibrationless, scientifically balanced rotors of welded steel or alloy, developed from many tests in the Buffalo Vacuum Test Pit. As the photos show, housings are readily adjustable to different discharge positions.

Do your operations include scale and water blowoff? Oil or gas furnace blowing? Or applications where small amounts of air at high pressure are needed? You'll find "Buffalo" Centrifugal Compressors a *real saving* . . . . both in first cost and long-range operation. Manufacturers in steel and iron are finding added "profit uses" for these economical blowers every day.

Your "Buffalo" engineering representative will gladly advise as to the exact size and type to meet your pressure blowing needs most efficiently. Why not ask him today?

BUFFALO FORGE COMPANY

173 MORTIMER STREET, BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

BULLETIN 3553, at left, gives you all performance data on "Buffalo" Centrifugal Compressors. It's yours for the writing.

"Buffalo" "First For Fans"

CENTRIFUGAL COMPRESSORS

If You ARE ON THE MAP *You Get* GOULD SERVICE

Lead is still critically short, so you must conserve your batteries. Call Gould and ask for a Gould service man. He will help you set up simple and effective charging and maintenance schedules that lengthen battery life.

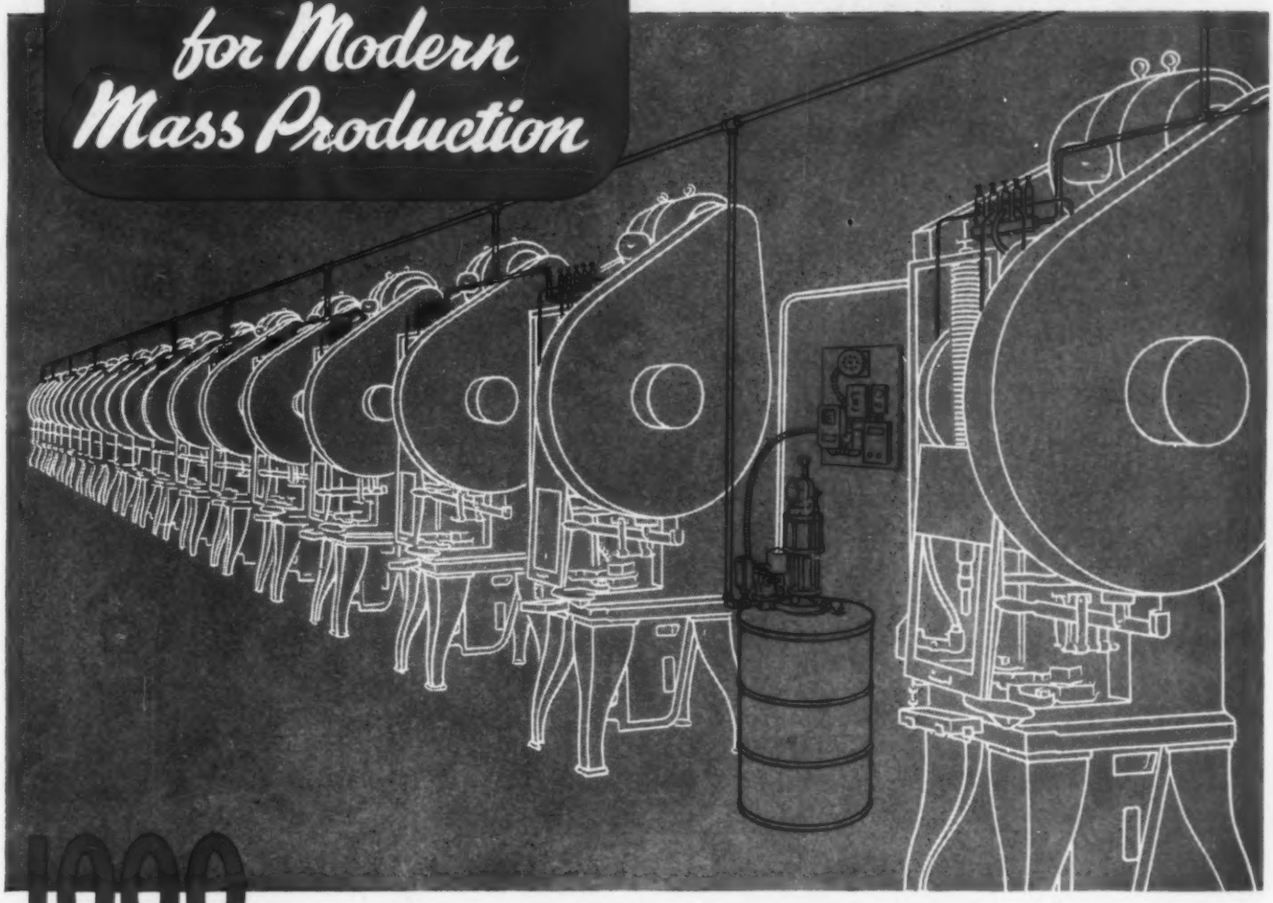
★ Gould Factories
● Gould Service Centers

For further information write Dept. 4-10, Gould Storage Battery Corporation, Depew, New York. Gould manufactures all types of industrial storage batteries.

GOULD
KATHANODE and Plante
BATTERIES

The Battery Picked by Engineers

Mass Lubrication for Modern Mass Production



1000 Bearings lubricated in 3½ minutes with a LINCOLN CENTRO-MATIC system . . .

Today's Modern Mass Production requires Modern Mass Lubrication to cut down maintenance costs, increase service-life and output of machinery. Lincoln Centro-Matic centralized lubricating systems guarantee positive lubrication with a metered quantity of lubricant . . . No shutting down of machines . . . No "hit or miss" methods.

The above schematic drawing illustrates a Lincoln Centro-Matic System installed in large Mid-Western industrial plant. It is typical of how these outstanding systems are being applied to lubricate industrial machinery. The installation is simple—all that is required is a Centro-Matic Injector connected to each bearing, singly or in manifold, and a single lubricant supply line from a centrally located lubricant pump, which can be time clock or push button controlled, power operated or manually operated. The flexibility of Lincoln Centro-Matic Systems makes it possible to install them on a single machine or a battery of machines and only one lubricant pump is required.

Engineering Service . . .

Lincoln Engineering Company has a staff of trained lubrication engineers ready to help you improve your lubrication methods. Ask for free engineering assistance or complete literature today. Mail coupon now.

LINCOLN

Pioneer Builders of Engineered Lubricating Equipment

Lincoln Engineering Company • St. Louis 20, Mo.

Please give me information on Centro-Matic Systems for (type of machine)_____. Please send me literature on Centro-Matic Systems ☐.

*Name*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

ISE B46-10

★Installations in many plants have proved that F.E.I. equipped furnaces have shown several times the expected pot life when compared to combustion equipment of conventional design.

The F.E.I. combustion system provides uniform top to bottom temperatures by circulating hot gases around the pot, thus eliminating any localized overheating and subsequent burning of the pot. An interesting feature of F.E.I. direct firing is the low temperature differential between the combustion chamber and the pot. The F.E.I. combustion system is completely automatic. It provides sufficient fuel capacity for high production requirements as well as low turn down for minimum operating requirements and for holding during idling. The human element in control is eliminated entirely. F.E.I. Galvanizing Furnaces have proved lower fuel costs per ton, improved quality and uniform coating, and lower maintenance costs per tonnage coated.

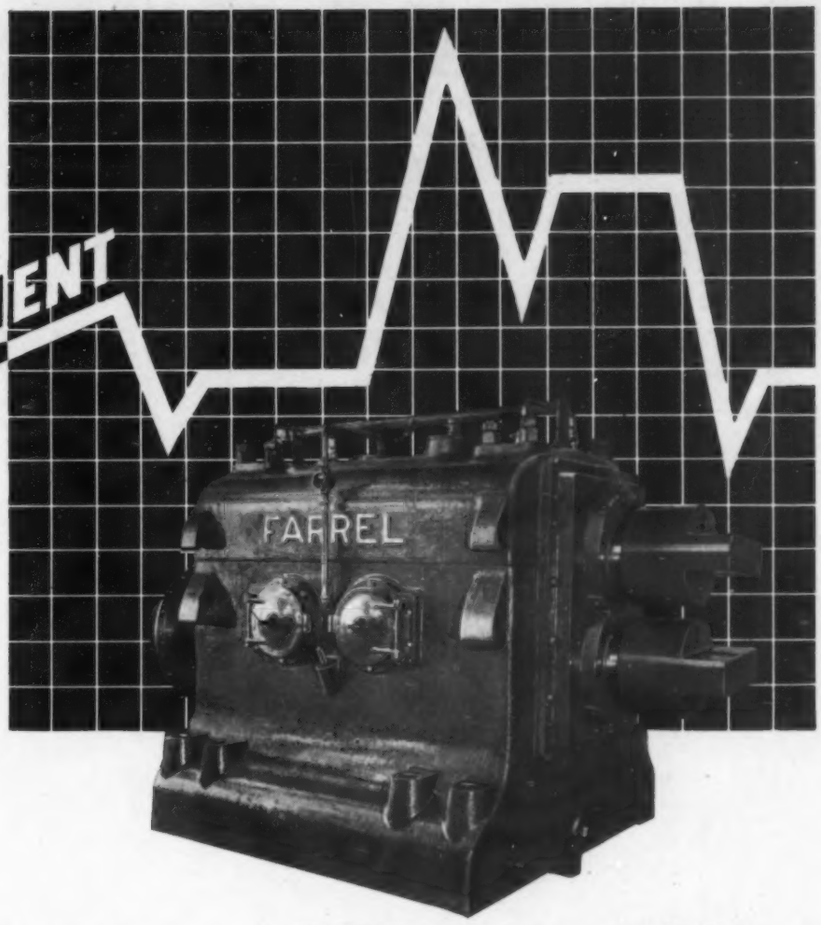
F.E.I.

FURNACE ENGINEERS, Inc.
1551 W. LIBERTY AVE., PITTSBURGH, PA.

• • • •

FOREIGN REPRESENTATIVES
FOR CANADA:
Salem Engineering (Canada) Ltd. Toronto, Ont.
FOR EUROPE, ASIA, AFRICA:
Salem Engineering Co. Ltd. Milford, Nr. Derbey, England.

HERE'S why this PINION STAND can take POWER PUNISHMENT



A Farrel pinion stand is built for the specific job it has to do . . . it is prepared and fortified by design to withstand the power shocks and stresses it will get on that job.

This "custom-tailored" protection safeguards power transmission efficiency through long trouble-free years of rugged duty. Every vital part of each unit is of a size and material which provides fully adequate strength to meet continuously the power "punches" and loads to be encountered.

1. HOUSING—Meehanite, cast steel or welded steel construction, designed to bear the brunt of rolling mill service and to maintain accurate alignment of the pinions.
2. BEARINGS — Babbitt-lined, steel-backed, sleeve bearings, or any approved make of anti-friction bearings—always amply proportioned for the job.
3. PINIONS — Continuous tooth herringbone, precision generated by the famous Farrel-Sykes process. The fact that the helices meet in sharp apices, instead of being separated by a center groove, provides extra strength and load-carrying capacity.
4. LUBRICATION—By dip-and-splash system, or force-feed by separate motor-driven pump or from centralized lubrication system, depending on conditions or requirements.

Farrel will design and build a pinion stand for your particular application that you can depend on for years of satisfactory service. Information will be supplied on request, and engineering help is available, if desired.

FB-338

FARREL ROLLING MILL MACHINERY

Rolls	Mill Pinions
Rolling Mills	Pinion Stands
Rod Mill Tables and Manipulating Equipment	Gear Drives of any Capacity
Universal Mill Spindles	Flexible Couplings
Rod Coilers	Roll Grinding Machines
Gears	Roll Calipers
	Lead Presses for Pipe or Rod

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN.

Plants: Ansonia, Derby and Stonington, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston, Charlotte

Farrel-Birmingham

DON'T BUY

CARBON BRUSHES

IT'S A FACT—you don't *need* to buy so many different types and sizes of motor and generator brushes! This has been established by surveys in various plants! A large steel company, for instance, discovered it could cut its brush items from 675 to 93. Another firm eliminated 2285 "necessary" brush sizes and shapes at substantial savings in ordering, billing, and in inventories.

Sponsored by National Carbon Company, Inc., this program of simplification of carbon, graphite, and metal-graphite brush needs can bring similar savings to you.

By making a few simple changes in present brush specifications, a comparatively few standard brush types and sizes will fill most of your varied needs.

HOW BRUSH SIMPLIFICATION PAYS:

1. Price advantage through quantity discounts.

2. Less money and space tied up in brush stocks.

3. Less time needed to handle stock.

4. Reduction of small orders—saving time in bookkeeping, billing, and accounting.

For further facts, get in touch with our nearest Division Office today. Dept. IS.

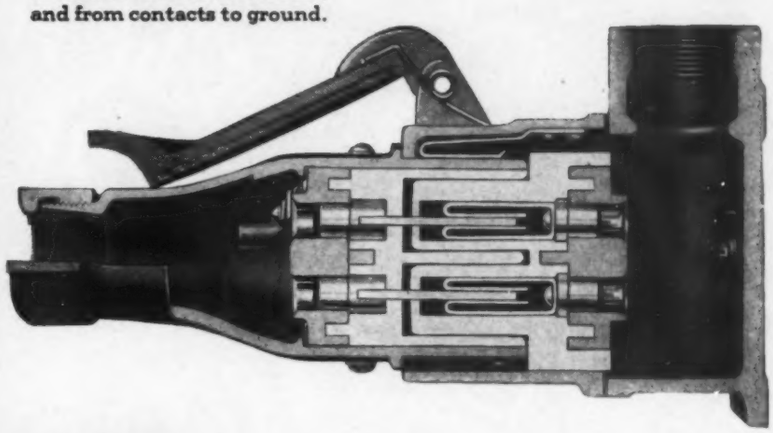
NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation
The word "National" is a registered trade-mark of National Carbon Company, Inc.

UCC

30 East 42nd Street, New York 17, N. Y.
Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

QuelArc Section; note long distances contact to contact, and from contacts to ground.



QUELARC circuit breaking plugs and receptacles

BUILT FOR MILL SERVICE

The QuelArc line of circuit breaking plugs and receptacles—ratings up to 200 amperes—is built to stand up in mill service, delivering dependable service with minimum maintenance. The exclusive QuelArc construction provides exceptional protection to the contacts, for safe use as current rupturing devices with heavy duty portable electrical equipment.

In the QuelArc design, note the complete enclosure of all contacts in insulating chambers, which form an arc-trapping space. Note also the long distances from contact to contact and from contacts to ground. Contacts are individually renewable and full ground protection is provided.

QuelArc plugs and receptacles are available in a complete line, 2, 3, 4 wire types; ratings 20, 30, 60, 100 and 200 amperes. Many other types of Pyle-National plugs and receptacles are available for portable tools, control and instrument circuits. Consult your Pylet catalog for complete listings.

PYLE-NATIONAL
RAILWAY ELECTRICAL EQUIPMENT
• SINCE 1897 •

THE PYLE-NATIONAL COMPANY

1334-58 North Kostner Avenue - Chicago 51, Illinois

Offices: New York • Baltimore • Pittsburgh • St. Louis
St. Paul • San Francisco

HEADLIGHTS • TURBO-GENERATORS • CONDUIT FITTINGS • FLOODLIGHTS • MULTI-VENT

FIRST COMMERCIAL TURBO-GENERATING SET IN AMERICA
De Laval generating set exhibited at Columbian World's Fair, Chicago, 1893.

A HALF CENTURY OF PROGRESS in TURBINE DESIGN by DE LAVAL

MODERN DE LAVAL MULTI-STAGE TURBINE
driving a 6,000 kw, 60 cycle alternator.

The highly perfected De Laval turbines of today are the direct result of the early achievements of Dr. De Laval, who in the year 1888 made the impulse type of turbine a practical and efficient power-producing machine by his invention of the diverging nozzle now employed in all impulse type turbines . . . For steam turbines of all types and sizes, consult De Laval.

T-1

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

DE LAVAL STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

SALES OFFICES ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER • DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON • KANSAS CITY • LOS ANGELES • MONTREAL
NEW ORLEANS • NEW YORK • PHILADELPHIA • PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • TORONTO • TULSA • VANCOUVER • WASHINGTON D.C. • WINNIPEG

Junction CONDULETS

for pulling and connecting electrical conductors — all sizes

The illustrations show a representative selection from the hundreds of different junction Condulets that are listed in Crouse-Hinds Condulet Catalog 2500. Many other housings in all sizes can be furnished with blank covers for use as junction Condulets.

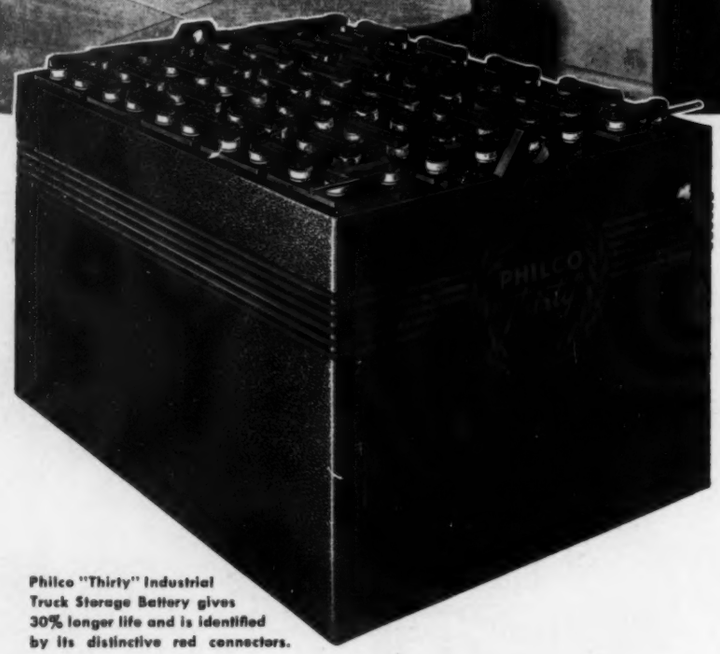
(CONDULETS are made only by CROUSE-HINDS)

No. 9
of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes—there is a wide variety of highly specialized types in each classification.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y., U. S. A.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. *Resident Sales Engineers:* Albany — Atlanta — Charlotte — Indianapolis — New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS



Philco "Thirty" Industrial Truck Storage Battery gives 30% longer life and is identified by its distinctive red connectors.

SPECIFY ELECTRIC TRUCKS POWERED BY MODERN EXTRA CAPACITY* PHILCO STORAGE BATTERIES

Get the kind of industrial trucks experience has proved the safest, most flexible and maintenance-free ... ELECTRIC TRUCKS! And specify by name the greatest materials handling development since the fork truck itself ... PHILCO "THIRTY", the battery with 30% longer life and 10% or more additional capacity! Where work schedules are heavy, this modern Philco-pioneered extra capacity* construction is practically a *must!* It is available in several Philco types in addition to the Philco "Thirty". Write for new catalogs giving specification data.

FOR 50 YEARS A LEADER IN INDUSTRIAL STORAGE BATTERY DEVELOPMENT

**PHILCO CORPORATION · STORAGE BATTERY DIVISION · TRENTON 7, NEW JERSEY*

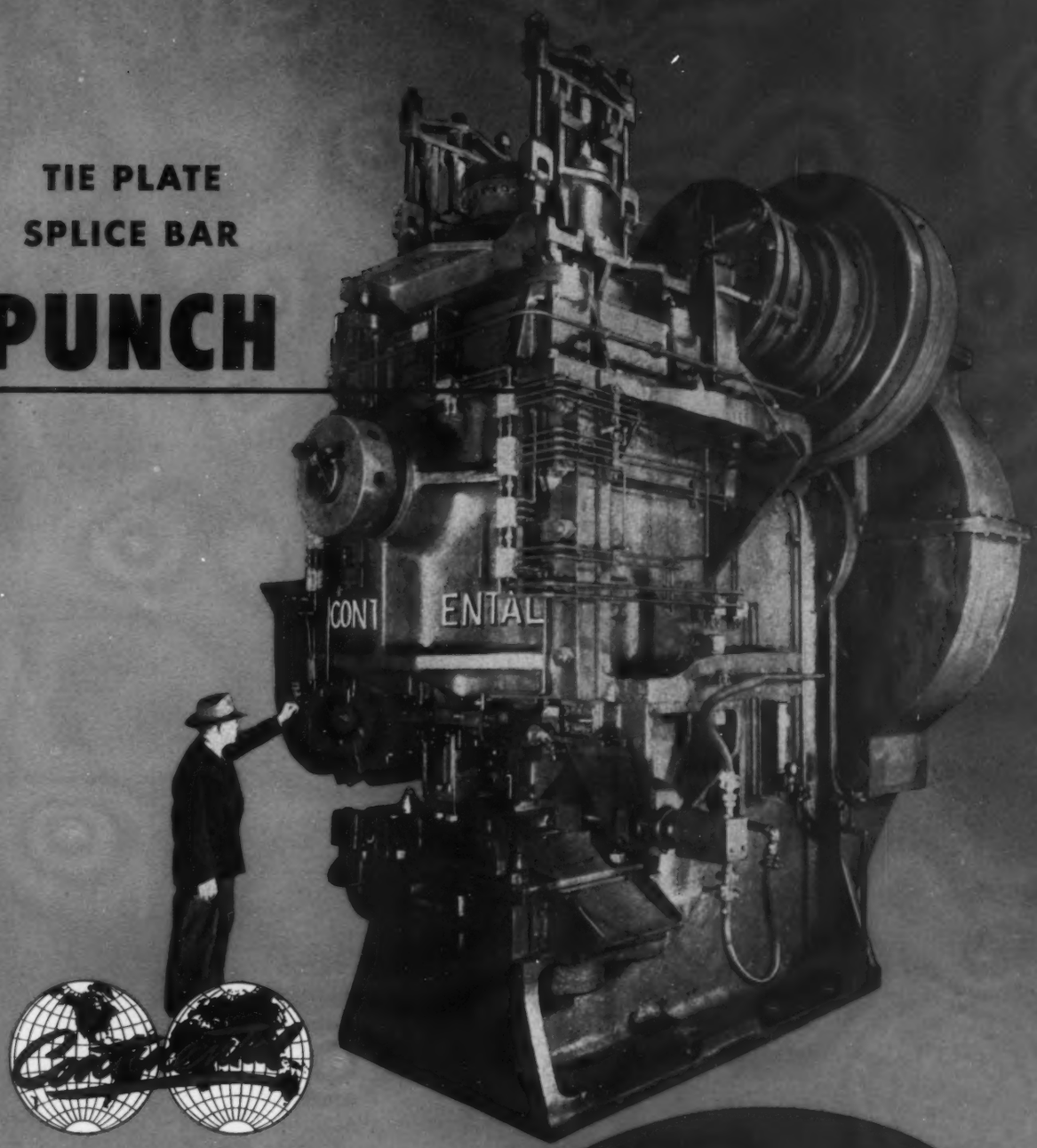
**Modern construction ... pioneered by Philco ... gives 10% or more additional capacity with no increase in overall battery size.*

PHILCO *Famous for Quality the World Over*

Continental

TIE PLATE
SPLICE BAR

PUNCH



Engineered with an exact knowledge of your problems in the mass production of tie plates and splice bars, this CONTINENTAL punch assures high speed, precision punching that helps to reduce costs. While specific in its application, this punch is typical of the advanced engineering and dependable manufacture always found in mill equipment by CONTINENTAL.

Continental

FOUNDRY & MACHINE CO.

PITTSBURGH · CHICAGO

Plants at: E. CHICAGO, IND. • WHEELING, W. VA.
PITTSBURGH, PENNA.

Never too big or too complex . . .

Continental

for dependable, uniform

CASTINGS

to specifications

Cutter Head for Hydraulic Dredge

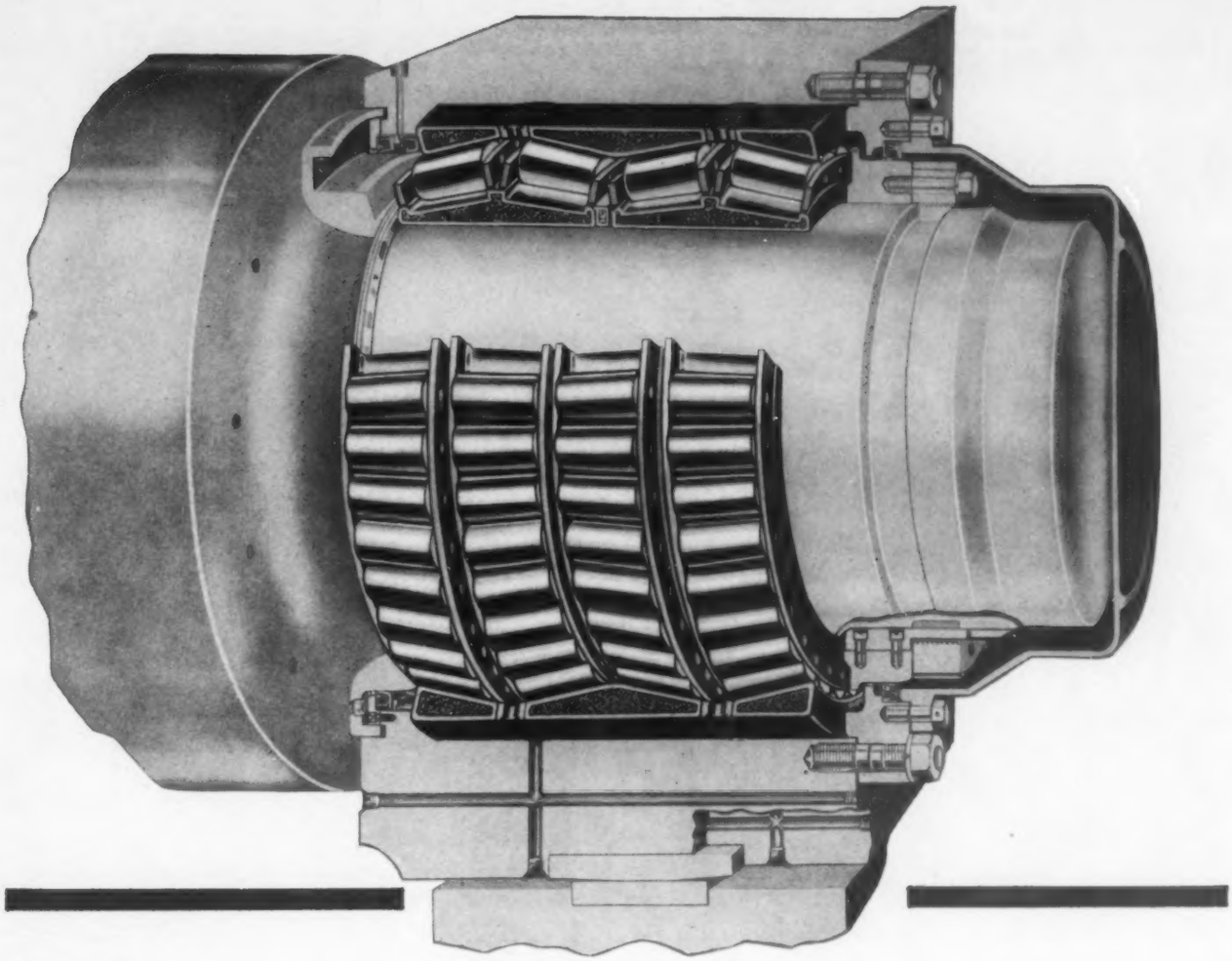
CONTINENTAL is headquarters for finest precision carbon and alloy steel castings of all types from 50 lb. production designs up to complex special castings weighing as much as 250,000 lbs. CONTINENTAL'S unexcelled facilities offer you the complete answer to all your casting requirements.

Continental

FOUNDRY & MACHINE CO.

PITTSBURGH • CHICAGO

Plants at: E. CHICAGO, IND. • WHEELING, W. VA.
PITTSBURGH, PENNA.



TIMKEN

BALANCED PROPORTION

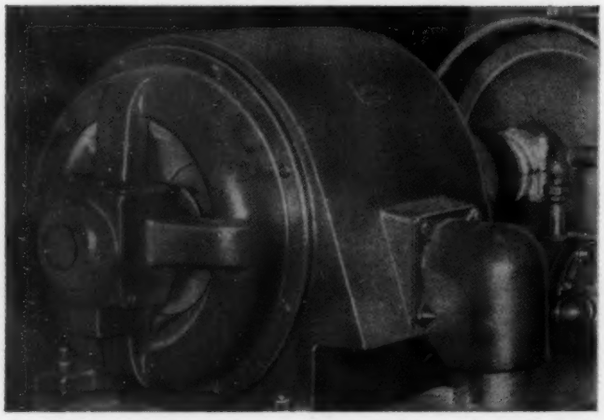
ROLL NECK BEARINGS

show load ratings up to 40% higher than previous Timken Roll Neck Bearings and assure 50% to 60% greater neck strength. For additional information, consult the mill builder or our engineers.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

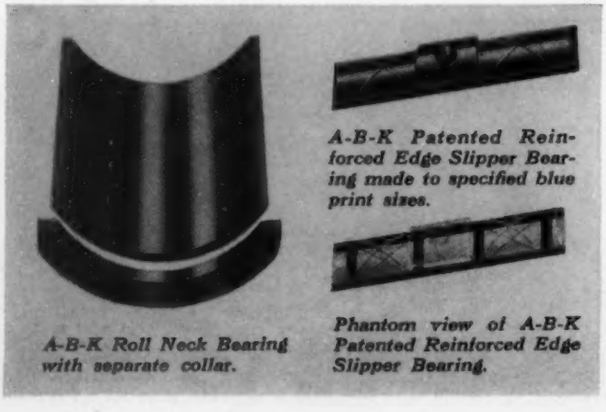
Why should steel mills use

LAMINATED PLASTIC BEARINGS?*



2. What reduction can be made in power consumption? Users report remarkable power savings, running to sizeable figures. Even *average* savings are surprisingly high. This is due to the hard, smooth surface of laminated plastic bearings and their exceptionally low coefficient of friction. Furthermore . . .

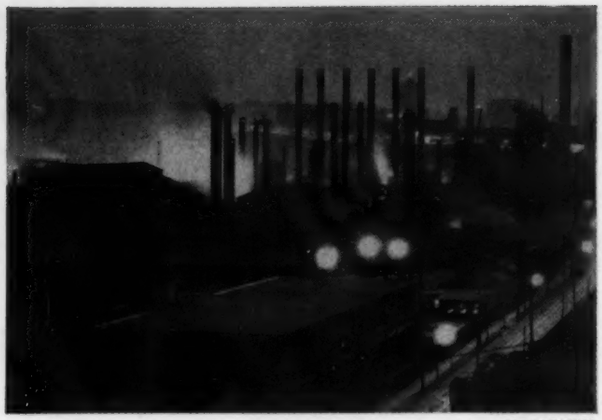
4. Why should you specify A-B-K Laminated Plastic Bearings? The engineering and research facilities of American Brakeblok Division, American Brake Shoe Company stand back of A-B-K Laminated Plastic Bearings. These bearings were designed for the tough jobs. They have met the severest tests of war production—are ready to serve you equally well in peace.



A-B-K Roll Neck Bearing with separate collar.

A-B-K Patented Reinforced Edge Slipper Bearing made to specified blue print sizes.

Phantom view of A-B-K Patented Reinforced Edge Slipper Bearing.



EWING GALLOWAY

1. Why should steel mills use laminated plastic bearings? Checks made at peak production prove that laminated plastic bearings reduce shut down periods for bearing replacement, lower power consumption, practically eliminate lubrication costs and outwear metal bearings. For example, . . .

EWING GALLOWAY

3. How much are shut down periods for bearing replacement reduced? Laminated plastic bearings often have a life many times longer than metallic bearings. Long life without failure means fewer bearing replacements—and naturally, a substantial reduction in lost production hours. Equally important to you . . .

5. For full information on A-B-K Laminated Plastic Bearings and their application to your steel mill bearing problems, phone, write or wire, American Brakeblok Division, 4600 Merritt Ave., Detroit 9, Mich.

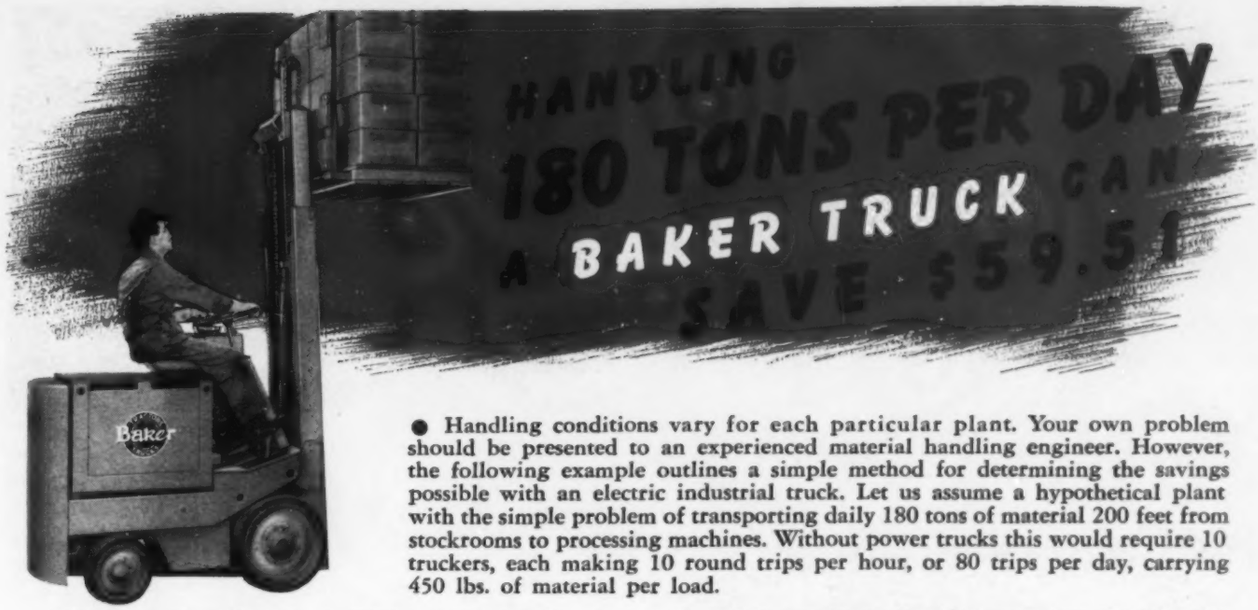
American Brakeblok

TRADE MARK REG. U.S. PAT. OFF.

***A·B·K Laminated Plastic Bearings**

Brake Shoe

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN



● Handling conditions vary for each particular plant. Your own problem should be presented to an experienced material handling engineer. However, the following example outlines a simple method for determining the savings possible with an electric industrial truck. Let us assume a hypothetical plant with the simple problem of transporting daily 180 tons of material 200 feet from stockrooms to processing machines. Without power trucks this would require 10 truckers, each making 10 round trips per hour, or 80 trips per day, carrying 450 lbs. of material per load.

TABLE I—*Handling Costs Without Electric Truck*

Based on 180 tons per day	*Cost per day*	*Cost per ton*
Labor (85¢ per hour)	$68.00	$0.378
Social Security Taxes	2.72	0.015
Workmen's Compensation	1.00	0.006
Hand Truck Depreciation	0.30	0.002
Total	$72.02	$0.401

COST OF MATERIAL HANDLING

Per ton—based on 180 tons per day

In addition to these savings, Baker Trucks reduce warehouse rental charges by tiering, contribute to plant safety, speed production and material movement, and perform many other operations that reduce plant overhead.

BAKER INDUSTRIAL TRUCK DIVISION
of The Baker-Raulang Company
2166 WEST 25TH STREET • CLEVELAND, OHIO
In Canada: Railway and Power Engineering Corporation, Ltd.

In order to mechanize handling operations, the following equipment would be required:

TABLE II—*Cost of Equipment for Mechanizing*

Fork Lift Truck 2000-lb. capacity	$4,100.00
Battery	600.00
Charging Equipment	840.00
200 pallets	700.00
Total	$6,240.00

The truck, handling one-ton pallet loads of material, making 24 round trips per hour, could transport the 180 tons in 7½ hours.

TABLE III—*Annual Expense—Truck Operation*

Depreciation—Truck at 10%	$410.00
Battery at 20%	120.00
Charging equipment at 6⅔%	56.00
Pallets at 20%	140.00
Tires	100.00
Repair and Maintenance—Truck	164.00
Battery	24.00
Charging Equipment	33.60
Replacement of damaged pallets	70.00
Electricity	82.00
Insurance	10.00
Total annual expense	$1,209.60
Expense per day	4.03

TABLE IV—*Handling Costs—With Electric Truck*

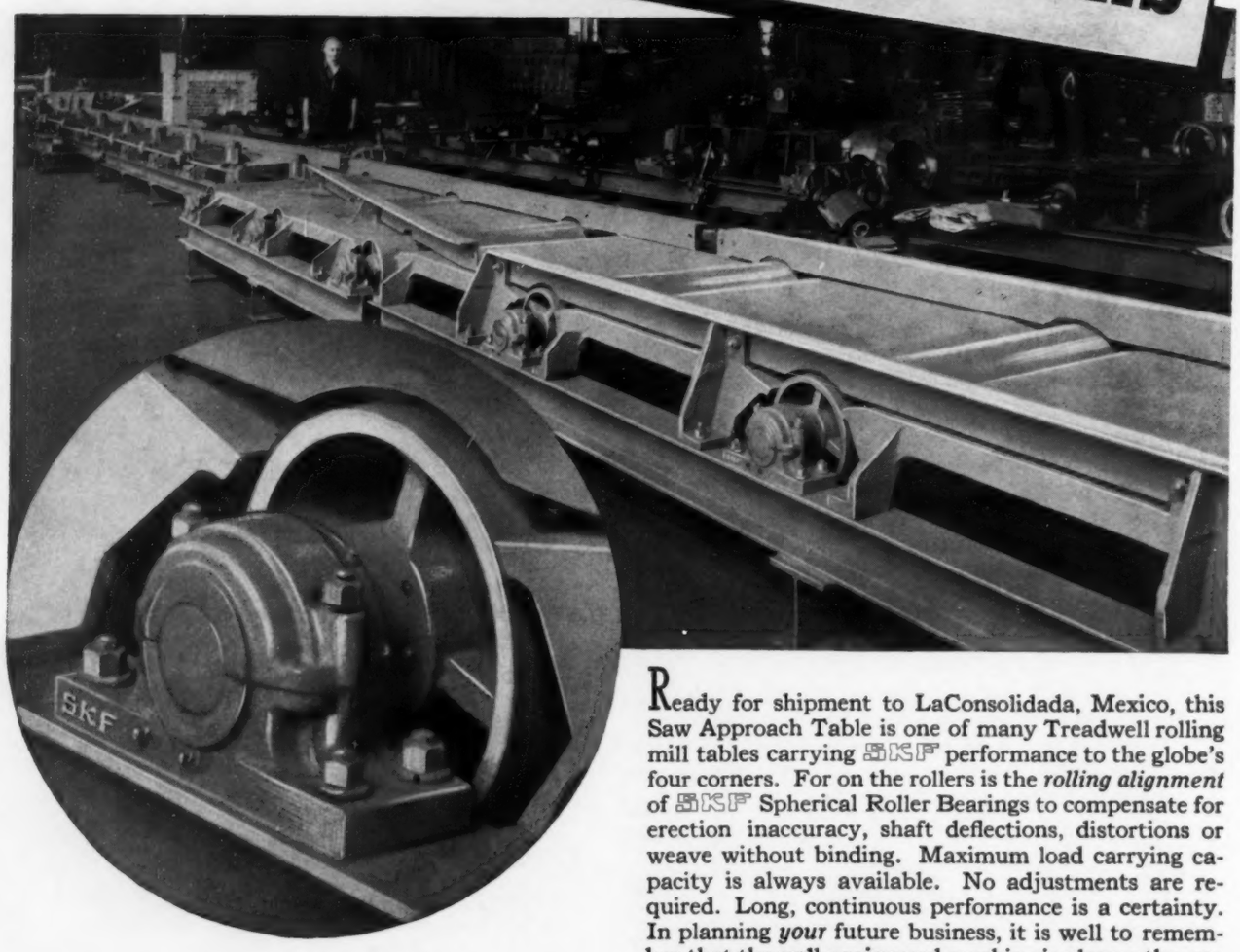
Based on 180 tons per day	*Cost per day*	*Cost per ton*
Labor (Driver—$1 per hour)	$8.00	$0.044
Social Security Taxes	0.32	0.002
Workmen's Compensation	0.16	0.001
Truck Expense	4.03	0.022
Total	$12.51	$0.069

TABLE V—*Savings With Electric Truck*

Savings Per Ton	$ 0.332
Savings Per Day (Handling 180 tons)	59.51
Savings Per Year (300 days)	17,853.00
Per cent Reduction in handling costs	83%
Annual earnings on investment	286%

While this example is obviously oversimplified, Baker Material Handling Engineers are prepared to show you how similar savings can be made on handling operations in your plant.

FOR GOOD NEIGHBORS



● *Built by Treadwell Eng'g Co., Easton, Pa., this Saw Approach Table depends upon compact, rugged, two-piece SKF Pillow Blocks to protect SKF Bearings from lubricant leakage, dirt and liquids.*

Ready for shipment to LaConsolidada, Mexico, this Saw Approach Table is one of many Treadwell rolling mill tables carrying SKF performance to the globe's four corners. For on the rollers is the *rolling alignment* of SKF Spherical Roller Bearings to compensate for erection inaccuracy, shaft deflections, distortions or weave without binding. Maximum load carrying capacity is always available. No adjustments are required. Long, continuous performance is a certainty. In planning *your* future business, it is well to remember that the well-engineered machine is always the one that's SKF-equipped. 6123

SKF INDUSTRIES, INC., PHILA. 34, PA.

Smooth Accurate Regulation

over the entire range of operation with the HAGAN V-Port Butterfly Valve

Accurate proportioning of fuel and air is essential in the modern furnace, where heat input may vary over a turndown range of 10 to 1. The need is particularly great at the low rates because at this time steel is up to temperature and most sensitive to furnace atmosphere.

At a minimum flow, the differential across regulating valves is usually the greatest. Losses across the measuring orifice, duct work and burner decrease, so that loss across the regulating butterfly must increase by a corresponding amount.

In the Hagan V-Port Butterfly Valve all of these factors are taken into account in port design, and smooth, accurate regulation is secured over the entire range of operation. The shape of the ports can be made to suit any given set of conditions, so that full advantage is taken of the inherent sensitivity and accuracy of regulating equipment.

Hagan V-Port Butterfly Valves are made in standard pipe sizes. They are ruggedly built and accurately machined. Our engineers will be glad to give you full information.

HAGAN CORPORATION, HAGAN BUILDING · PITTSBURGH 30, PENNSYLVANIA

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

SPOT CONVERSION of A-c. to D-c. Power

FOR EFFICIENT STEEL MILL PROCESSING

FIRST STEP

Typical Motor-generator Sets, which are exposed to accumulations of dust, dirt and harmful abrasives.

RELIANCE V★S DRIVE

THE FINAL STEP

Reliance V★S Drive (for on-the-spot conversion of A-c. to D-c. power) are compact, conveniently-packaged, factory-wired units. Filtered, ventilated, always clean—they offer you all the advantages of a separate motor room.

★ ★ ★

V★S, the *All-electric, Adjustable-speed Drive for A-c. Circuits,* is available in sizes up to 200 horsepower. The great flexibility this drive brings to any operation includes an infinite range of stepless speed changes—instantaneous stops and starts and many other specialized functions. Control can be automatic or manual—either at the machine or from remote stations. You will find more important information on how V★S increases production and cuts costs in Bulletin 311. Write for it today!

RELIANCE ELECTRIC & ENGINEERING COMPANY
1084 IVANHOE ROAD • CLEVELAND 10, OHIO
Sales Representatives in Principal Cities

RELIANCE A-C D-C MOTORS "MOTOR DRIVE IS MORE THAN POWER"

Here's one "secret weapon" that needs to be unveiled in every corner of the land...

THE ENEMY: Tuberculosis, the dread White Plague which kills more Americans between 15 and 35 than any other disease.

THE WEAPON: The X-ray, surest means of catching TB early, when it can be cured more easily and before it spreads.

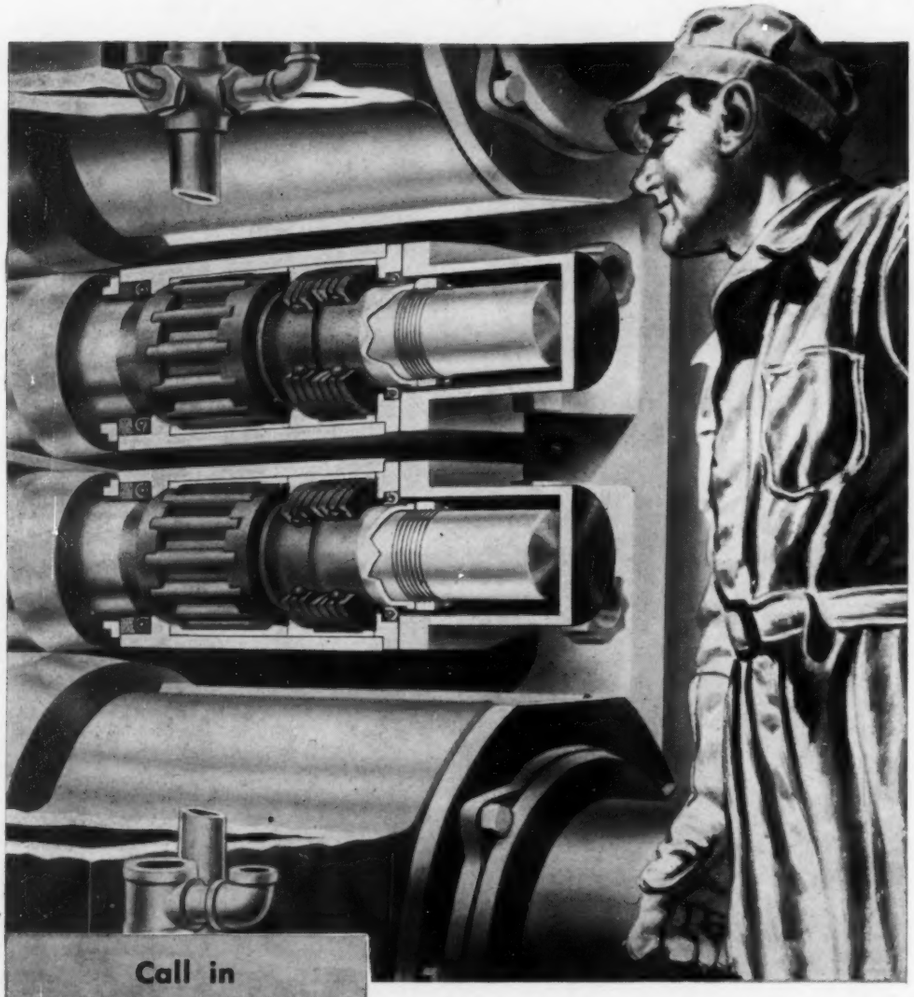
Christmas Seal money fights TB in many ways; one of the most important is to buy X-ray units and promote mass examinations. Please, send in your contribution today.

BUY CHRISTMAS SEALS

Because of the importance of the above message, this space has been contributed by

IRON AND STEEL ENGINEER

Grease gets the works



in these work-roll bearings!

Call in SOCONY-VACUUM for this Correct Lubrication Program

- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
- Skilled Engineering Counsel
- Progress Reports of Benefits Obtained

GARGOYLE Lubricants

IF there's any place where grease really gets a workout, it's in these steel mill work-roll bearings! First, it is subjected to terrific pressures and shock loads that tend to squeeze it from the bearing surfaces. Second, it has to resist excessive softening and deterioration due to high temperatures. Third, it must stick to the job in spite of the washing action of scalding water.

That's a tough combination for any one grease to beat. Yet Socony-Vacuum's patented Gargoyle Grease Sovarex L successfully meets all three conditions. It resists rupture even when squeezed to microscopic thinness — constantly guards against friction and wear. It's in service now under temperatures as high as 450°F. It is staying on bearings in extreme cases where they are actually flooded with water.

Gargoyle Grease Sovarex L was produced especially for work-roll, back-up roll, and table-roll bearings. However, mill operators are now using it in as many as 56 different spots where similar conditions are encountered. Get detailed facts and figures on performance from your Socony-Vacuum Representative.

Socony-Vacuum Oil Co., Inc.

and Affiliates: Magnolia Petroleum Company, General Petroleum Corporation

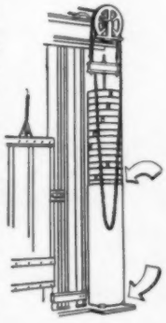
R-S FURNACE FACTS

ISSUED MONTHLY BY R-S PRODUCTS CORPORATION, PHILADELPHIA 44, PA., FOR THOSE CONCERNED WITH QUALITY HEATING OF METALS

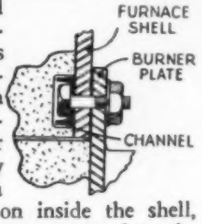
Furnaces Designed for the Men Who Run Them . . . as well as for the Product and the Treatment

Any *good* furnace handles the work surely, holds its temperature on the nose, and keeps up with production rates. But a *fine* furnace does more. A *fine* furnace takes into account the man who runs it. R-S has made *fine* furnaces for 38 years.

Take the matter of workmen's toes smashed beneath improperly guarded door-counterweights—or the matter of counterweight guards which become waste-baskets for lunch-pail refuse. R-S intentionally plans every guard sufficiently high and close-fitting to discourage its use as a receptacle—but never tries to save a foolish penny by omitting it.



Then there's the business of mounting burner plates. Heads of bolts which lie between furnace shells and refractory linings will work loose and spin under the wrench, unless restrained. On the other hand, welded studs make replacement hard if threads are stripped or damaged. R-S has been using a simple ingenuity to answer the enigma for many years. It welds a short channel section inside the shell, just large enough to accommodate the bolt head across its flats. The bolt is free, but it can't turn.



Now let's suppose you're a car-hearth or kiln-type furnace user. That means a sand seal—made by the average furnace builder of unyielding angle-iron or cast webs. Think of what could happen when work-pieces or tools tumble into such a seal and jam it! R-S outguesses trouble by making the male web of any sand seal thin enough (16 gauge) to "give" in an emergency—to allow cars to be drawn without furnace shut-down.

And finally, what about those leaks through peep holes, which keep furnace men busy shaving brick plugs and burning their fingers? R-S thoughtfulness of detail calls for free-acting covers which fall shut by gravity, and have opening-ears you can engage with anything from a lead pencil up.

Think of the men who run your furnaces the next time you plan a new one.

LAMENT IN LIMERICK

There was a heat treater from Wheeling
Who had a peculiar feeling.
He broke a prime rule,
Shut off air before fuel,
And his furnace went up through the ceiling.

•

P.S. Had it been an R-S furnace (always equipped with safety shut-off valves) the last line would read differently.

Furnace Family—for a Foundry

This battery of four R-S furnaces at General Metals Co. (Oakland, California) is an excellent example of convenience and flexibility in heat treating steel castings. One furnace (right) is extra-big—for the huge work and the larger charges. It goes to 2000°F. One furnace (second from left) is of the convection type, for all operations from 600 to 1250°F. Its external heater may be seen behind the column at the left of the furnace. The other two units are direct fired for work from 1200 up to 2000°F.

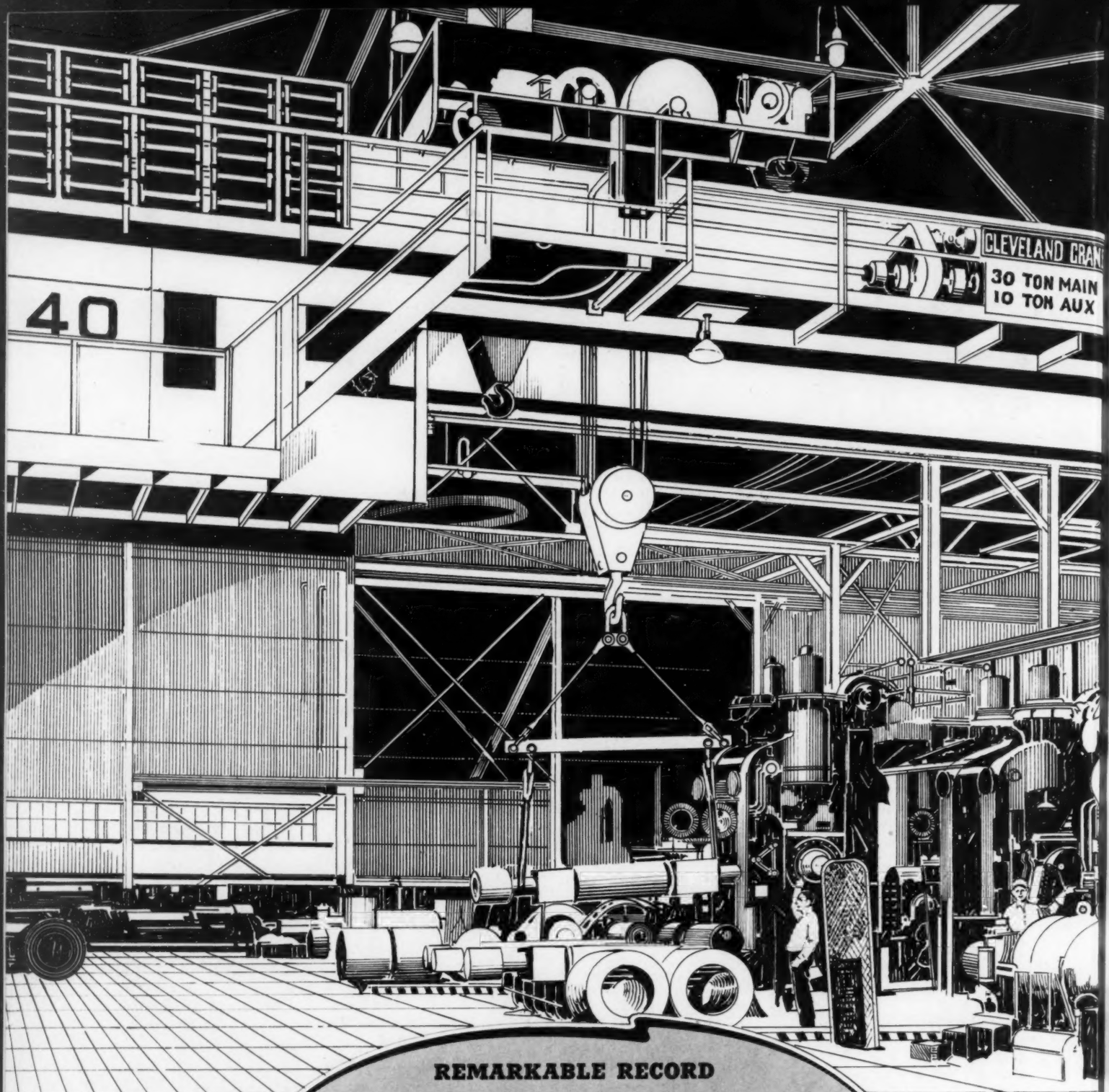
Note also the transfer car pit, the craneway planning, and the direct motor drive on the transfer car, the furnace cars and the large furnace door. Firing in all cases is with combination oil and gas burners, to take advantage of seasonal gas rates and favorable and unfavorable oil supply situations.

Here is a heat treat department wisely designed for adaptability to the fortunes and fluctuations of the business it serves.

J. H. Sipchen Heads New R-S Sales Group in Chicago

Welcomed this summer to the field sales and engineering family of the R-S Furnace Division was J. H. Sipchen Co., who will service forging, foundry, steel-mill and heat-treating users of furnaces in Illinois, Wisconsin, Lake County (Indiana), and the Tri-cities. With Sipchen, at 549 N. Washington Boulevard, Chicago 6 (phone—Randolph 0709), will be Paul Miller, erstwhile of the W.P.B.

Known for 20 years throughout mid-west heavy industry, Sipchen's more recent affiliations have been V.P. and Gen'l. Mgr. of Hannifin Manufacturing Co., Asst. to Pres. of Anker-Holth, and V.P. of Manufacturer's Equipment Co. Possibly his best known current work is in behalf of Erie Foundry Co., steam and board drop hammers, trimming presses and hydraulic presses. JMLooPK-1



REMARKABLE RECORD

For continuous year in and year out service, Cleveland Mill Cranes have a remarkable record. Despite severity of service and often-times considerable abuse, Cleveland's will be found doggedly at it. Among steel mill engineers who know, who have tried them all, Cleveland all-welded cranes rate high.

THE CLEVELAND CRANE & ENGINEERING CO.

1131 EAST 283 RD ST. WICKLIFFE. OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops and Shorts

WITH the 1945 convention and exposition of the Association of Iron and Steel Engineers now a matter of history, it is interesting to review the activities of this postwar meeting. An enlarged technical program, plus the largest iron and steel exposition ever held, combined to produce a new record attendance, although some of the old familiar faces were kept at home because of strikes, etc. Resumption of ladies' entertainment again brought out the distaff side. Cleveland hotel facilities were taxed, but cooperative efforts nicely took care of the problem. Everyone seemed to enloy themselves while getting in some good licks of work. And now it is over for another year, when we will be back in Pittsburgh, September 22, 23, 24 and 25.

▲

E. M. RICHARDS, operating vice president of Republic Steel Corporation, speaking at the annual dinner, urged union leaders to avoid acting for immediate expediencies and temporary advantages and to adopt long range planning that will protect their long term position. He admonished the heads of unions to see that their men respect the sanctity of contracts and to see that they recognize the power of economics which, if disregarded, will hurl us down the disastrous path of inflation.

▲

BEST crack heard around the convention came in a voice with a decided southern flavor: "We had to start up our rolling mills so we could get enough scrap for our open hearths."

▲

NOT a part of the convention but nevertheless adding spice to the preparations was Pittsburgh's power strike, which for a time threatened the completion of necessary printed matter and miscellaneous material in process. Thanks to the efforts of a small group of power company supervisors, sufficient power was maintained to supply essential uses and some light commercial uses. Meanwhile, a large city was paralyzed by a small group of wilful men under irresponsible leaders, who unlawfully picketed transportation facilities in order to add to the public's inconvenience. And just to rub it in, the transportation men, who refuse to cross a picket line although they are not in sympathy with the strike, are applying for unemployment compensation which will be paid from taxes coughed up by the inconvenienced public.

▲

JUST by way of injecting a cheerful note, the August ingot production of 6,895,465 net tons set a postwar record.

▲

TYPICAL of Americans' reluctance to start at the bottom is their pronounced distaste for apprenticeship. Business men who have studied the problem feel that we will never have skills in certain trades without immigration, which will probably have to be continuous, as the second generation Americans pick up the national apathy toward apprentioeship.

▲

SOMETHING of a minor craze has developed for combing through post office lists to discover names of places that fit the states in which they are located. Such places include Hittor, Miss.; Oola, La.; Proan, Conn.; Shapeless, Mass.; Praise, Ala.; Goodness, Me.; Farmerina, Del.; Deathly, Ill.; Coco, Colo.; and Income, Tex. Personally, we think the old fashioned way of playing post office is more fun.

▲

THE second round of bids for the DPC plant built at South Chicago by Republic Steel Corporation shows Republic to be high bidder at $30,000,000. It is estimated that conversion of the plant to peacetime production will require the expenditure of another $20,000,000.

▲

APPROXIMATELY 10 per cent of the overall steel production of the United States is being exported. Sheet steel exports, however, comprise only 2.7 per cent of sheet production.

▲

THE proposed nationalization of the British steel industry will proceed along a plan by which the government will purchase controlling interest in the principal companies. These sales will be compulsory at prices fixes by arbitration. The government will provide capital for the development of the industry.

▲

TO assist in impressing the traffic safety campaign upon public consciousness, Birmingham's famous statue of Vulcan which overlooks the city from a nearby mountain now carries an electric torch which is normally green but which becomes red for 24 hours after a traffic fatality.

▲

INDICATIVE of the coal industry's determination to hold on to its markets is the order for two powdered coal fired gas turbine locomotives, placed by Bituminous Coal Research, Inc. These units, the first in the world, will be rated at 3750 hp. The gas turbines will drive generators which will supply power to the traction motors.

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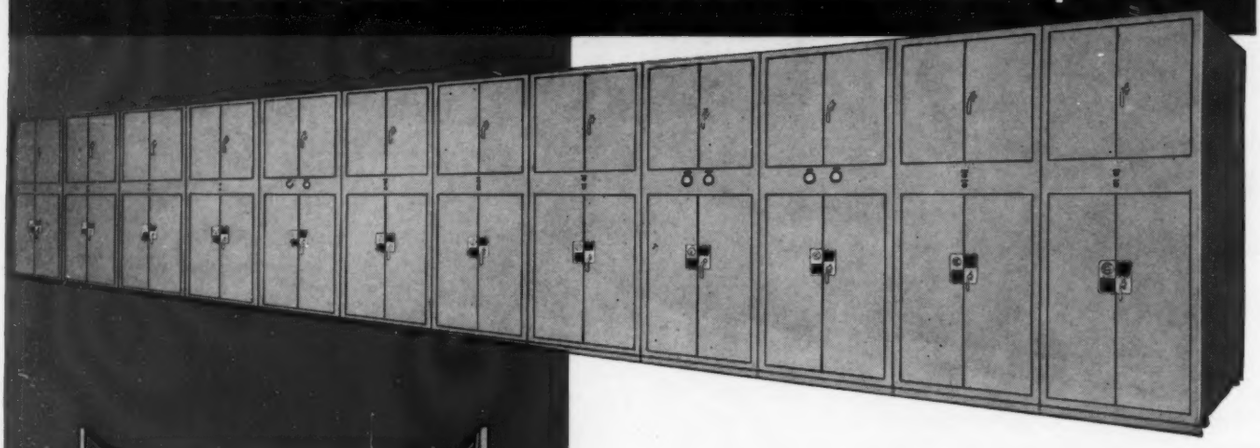

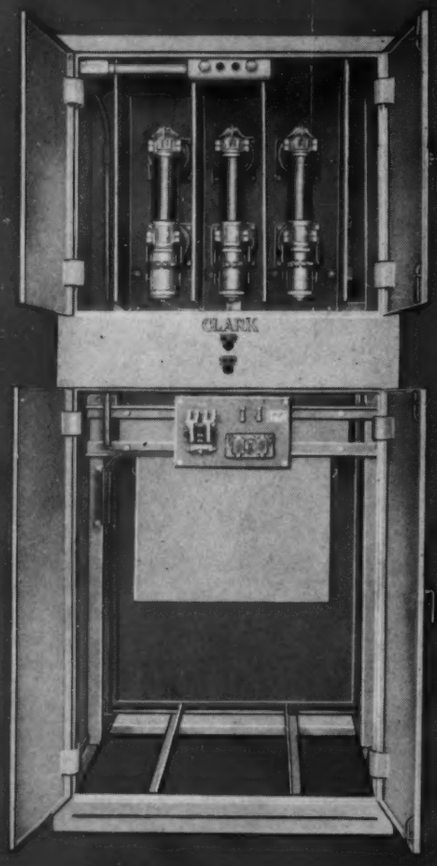

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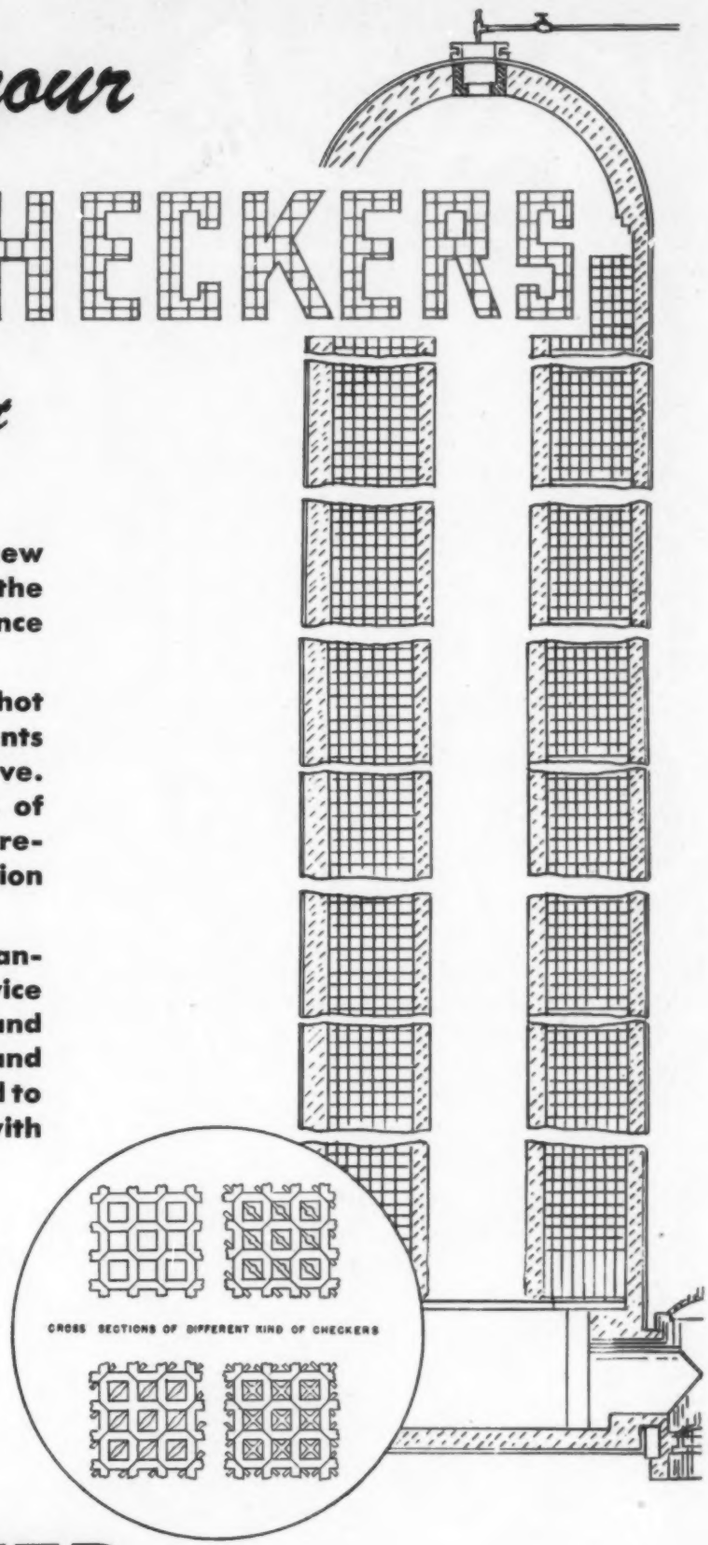

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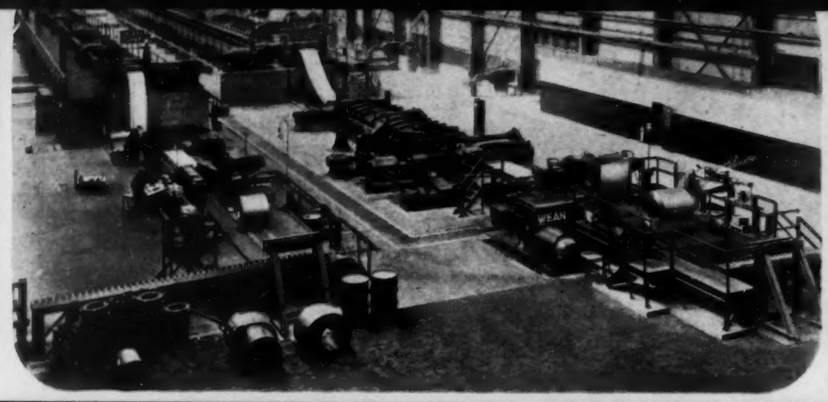

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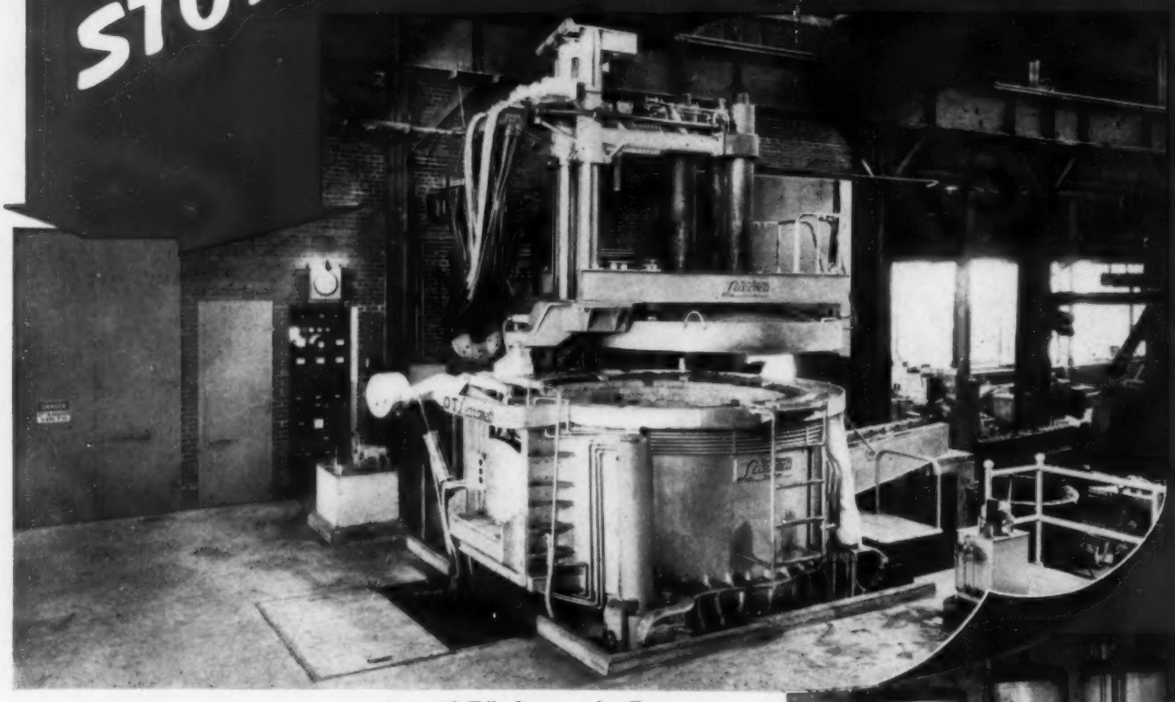

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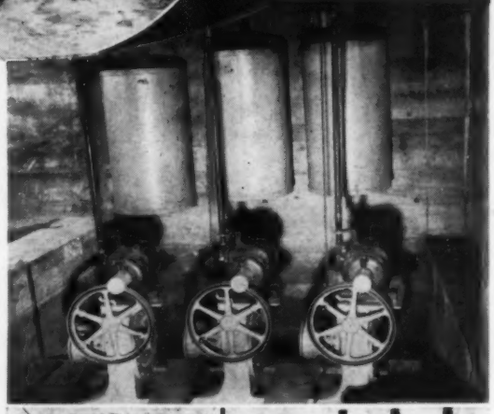

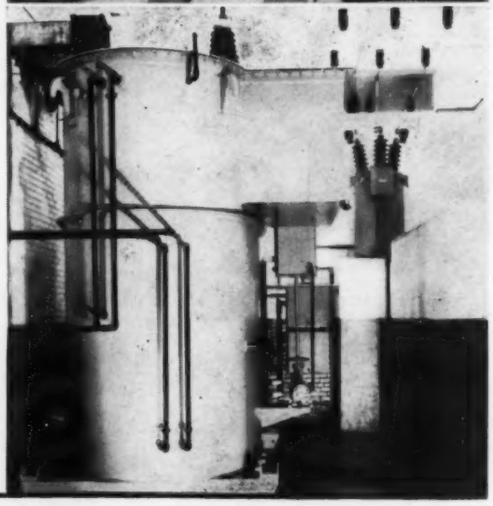

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Modern Steel Providing Methods

. . . . by proper use of the available tools, a provider can easily obtain the maximum possible yields for any given set of mill conditions . . . .

by R. W. Graham

ASSISTANT DIVISION SUPERINTENDENT

SLAB AND PLATE MILLS

CARNEGIE-ILLINOIS STEEL CORPORATION

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▲ DURING recent years important advances have been made in the metallurgy of rolled steel products, and in the design, construction, and operation of modern rolling mills. These improvements in steel making practices and processing facilties have made it possible to convert larger percentages of the ingots into prime and salable product. The percentage of prime product obtained from a given weight of material charged is commonly referred to as yield, and it is with this important factor that this paper is concerned.

While vast amounts of material relating to rolling mill operations and equipment have been prepared for publication or for discussion, in most instances these data have been concerned with equipment and facilities. The present paper has been written with the assumption that real benefits can be derived from comprehensive studies of means for utilizing to the best possible advantage the equipment and materials now at hand.

Most mills use the term "providing" to mean the process of converting product sizes into semi-finished sizes and weights, and in converting semi-finished sizes and weights into ingot requirements. A provider must work backward from specific customer requirements to open hearth heat orders, taking into account all mill limitations, specification requirements, and all losses inherent to the operation involved. In many instances this work is still done by rule-of-thumb methods, many of which are clumsy, inaccurate, and outmoded by improved equipment. While providing is essentially a clerical function, the methods used for the work directly affect mill production rates, mill yields, and overall production costs. Since providing is so intimately related to all phases of mill operation, it seems desirable that careful consideration be given to providing methods, and to the possible need for changes to correspond with current changes in facilities and in steel quality.

A prerequisite of any providing method is simplicity. If errors are to be avoided, mental or pencil calculations must be kept to a minimum. Methods should be positively specified and completely outlined so as to eliminate guesswork, and as conditions change or as new products are developed, field studies must be made in order to keep the providing procedure up to date. No degree of care and accuracy on the part of the provider will consistently give satisfactory results unless frequent and thorough checks are made at the mill to verify the correctness of the procedures being used.

INGOT PROVIDING

Many primary mills producing semi-finished material for re-rolling still use the old providing procedure which involves the use of an assumed yield. Using this method, it is first necessary to calculate the product weight desired from each ingot, taking care to arrive at weights that will permit pouring of the largest possible ingot. This product weight is then divided by the assumed yield, say 84 per cent, and the resulting figure represents the required ingot weight. Where such calculations are used, no correction is made for ingot length. It is obvious that such methods cannot be correct for maximum and minimum lengths of ingots, if there is any appreciable spread between the two extremes. The result is that many of the short ingots do not produce the required amount of product after adequate discards are taken, and in many instances, excessive scrap is encountered in the longer ingots. Either extreme is

Presented before AISE Spring Conference, Chicago, Illinois, May 7, 1946.

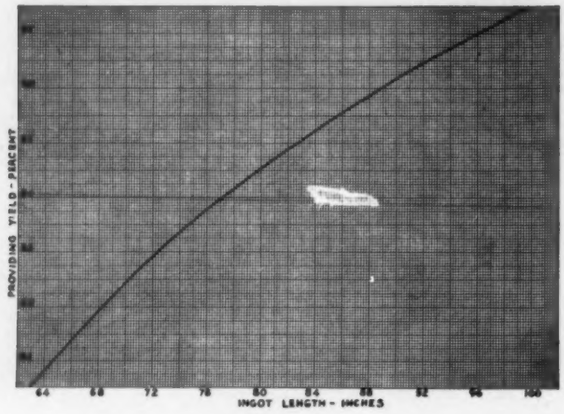


Figure 1 — This curve anticipates a constant providing loss of 5500 lb on 29 x 66 in. ingots when rolled to yield slabs 60 x 4 in. to 60 x 8 in.

costly and undesirable since it is usually difficult to dispose of odd cuts or shorts, and of course any excessive scrap represents a direct loss.

A more modern method of ingot providing is built around the assumption that the sum of top and bottom crops plus heating losses is a constant, regardless of ingot height. This thought, of course, implies variable yield, the smaller ingots having the lower yield, and the maximum length ingots yielding the largest percentage of usable product. Metallurgically, this concept is sound, and in actual practice it has had the two-fold beneficial effect of increasing average mill yields, and of reducing the number of short cuts produced.

Figure 1 shows yields anticipated by the provider for semi-killed steel in 29 × 66 in. moulds for various ingot lengths. Prior to the institution of this providing method, the particular mill using this chart provided by using an assumed yield of 85 per cent for all ingot lengths. The curve indicates the obvious error in this method and explains loss of yield on long ingots as well as excessive shorts on the shorter ingots.

Example:

Product required	4 slabs at 9,000 pounds each
Total weight of product	36,000 pounds
Providing loss	5,500 pounds
Weight of ingot	41,500 pounds

In using this method, all long division is eliminated and the providing calculations are reduced to simple addition. This type of calculation has a tendency to reduce clerical errors, and at the same time the provider has at hand a tool which will permit him to cut the maximum permissible yield regardless of ingot length. The key to the method, of course, lies in the establishment of proper provision for losses. These will vary with each ingot size, with ingot contour, with the amount of scale loss in soaking pits, and are sometimes affected by blooming mill rolling practice. The providing loss for each condition must be determined by field observations.

The data for Figure 1 assume that a providing loss of 5,500 pounds can be used for all slabs 60 in. wide and 4 to 8 in. thick. Rolling this ingot to narrower sizes would cause increased distortion of the ends of the ingots, resulting in a greater loss, for which proper provision would have to be made. Extremely thick slab sizes would similarly require larger loss allowances. Figure 2 shows providing losses allowed by one mill for 27 × 57 in. ingots. In this procedure, the loss varies with slab thickness, maximum yields being realized for the thin slabs, and from the longest ingots.

STRUCTURAL SHAPE AND BAR PROVIDING

The principle involved in the ingot calculations can also be applied to advantage in structural or bar mill

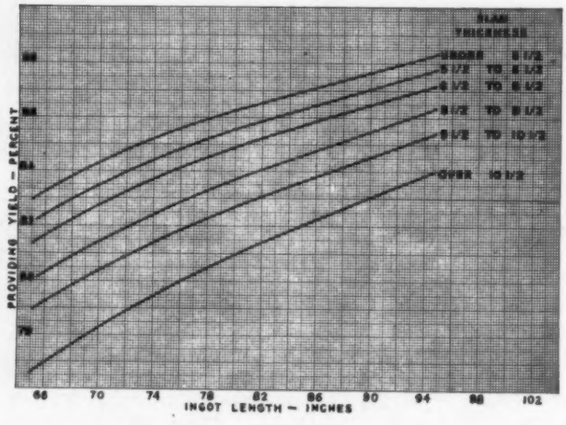


Figure 2 — Providing yields for 27 x 57 in. ingots when rolled into slabs 51 to 54 in. wide.

providing. The use of a constant end crop and scale loss for a given section will again permit providing for maximum yields regardless of product length. In this instance again, the actual yield will be greatest when the mill is rolling maximum lengths.

The application of such a providing method has the greatest value for mills that produce a given section in a wide range of rolled lengths, and has the least advantage over other methods for mills that deliver fairly constant lengths.

SHEARED PLATE PROVIDING — THREE-HIGH MILLS

For many years, practically all sheared plate tonnage was rolled on single-stand three-high mills. On such mills, width control is poor, and the gage difference between edges and center of plates varies widely, depending upon mill conditions. The variable side scrap, in conjunction with variable center gage or crown in the plates, caused extremely wide variations in the providing requirements, and of course in most instances, the provider had to allow enough weight to compensate for the worst conditions.

Three-high plate mills have definite limitations on the over-all length of product that can be rolled. While plates up to 60 feet long can be rolled, special mill conditions are required for such production, and under

TABLE I

Plate Providing Table for Typical Three-High Plate Mill

Width of finished plates inches	Percentage additions for plate thicknesses shown											
	¼	10.2	⅜	15.3	½	20.4	⅝	25.5	¾	30.6	1	40.8
30 to 50	22	17	22	18	22	19	23	19	24	20	25	22
Over 50 to 70	23	17	23	19	23	19	24	20	24	21	25	23
Over 70 to 80	23	18	23	18	23	18	24	20	24	21	25	23
Over 80 to 90	24	18	24	19	24	19	24	20	25	21	26	23
Over 90 to 100	24	19	24	20	24	20	25	21	26	22	27	24
Over 100 to 110	25	21	25	21	25	21	26	22	27	23	28	25
Over 110 to 120	27	22	27	23	27	23	27	23	29	24	29	26

Percentages indicated in the tabulations apply as additions to the theoretical plate weights.
Example: Plate Size — ¼ x 72 x 360 in.
Theoretical Weight = 1836 lb
Slab Weight = 1836 + (0.23 x 1836) = 2258 lb

ordinary conditions maximum lengths are held to 40 feet or less. As plate sizes approach the maximum widths and the minimum gages that can be rolled on any particular three-high mill, the maximum lengths must be reduced. With certain requirements of width and gage the maximum length may be less than 20 feet.

There are two methods used in designating plate thickness. When a customer specifies plate thicknesses in terms of pounds per square foot, the mills are held

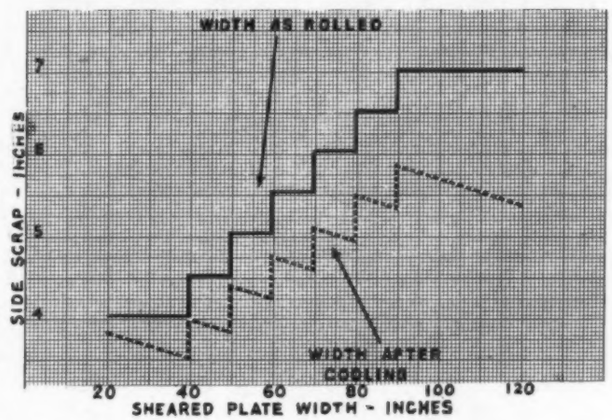


Figure 3 — Chart showing allowance which provider makes for shrinkage in width of plates.

to rather close weight tolerances, with all allowable variations being in terms of percentage over and under the theoretical weight. In this instance, there is no minimum thickness requirement. However, if the customer elects to specify thickness in terms of fractional or decimal inches, the mills must produce plates that are not more than 0.010 in. under the specified thickness. The over tolerance is again given in terms of per cent of theoretical weight, but in this instance the allowable overweight is much greater than it would be if the orders had been entered to weight gages.

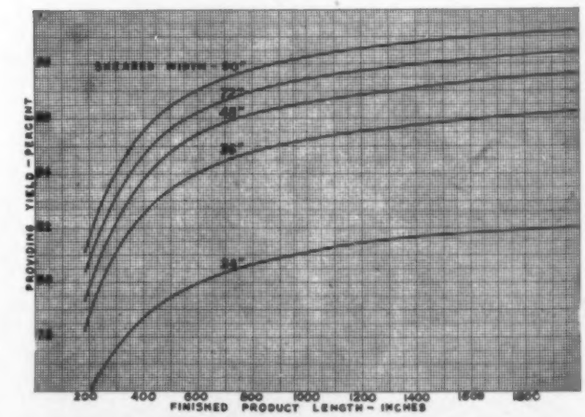
Table I shows a providing table used for computing slab weights for a typical three-high plate mill. The example included with the tabulation shows the calculation involved in the provision. It will be noted that provision factors are different for a given plate thickness depending upon the manner in which plate thicknesses have been specified.

This table neglects the effect of plate length. Since lengths on the mill involved normally vary only between 20 and 40 feet, the error resulting from this omission is not too serious. Extremely long plates, which should theoretically result in improved yield, actually require providing allowances greater than those shown in the tabulation to compensate for additional side scrap which must be added because of excessive camber.

The providing methods which use tables like this one impose undue responsibility upon the provider. Extremely long plates, or thick plates, are not covered by the table and the provider must vary the allowance for such special instances. Orders requiring special weight tolerances, or qualities requiring excessive amounts of slab conditioning, are also special cases, and the provider must adjust the providing allowances according to past experience with similar conditions.

It will be noted that the basis for all calculations is the theoretical plate weight. Any undetected error in this weight will result in incorrect slab weights and thus in possible loss of product. Many orders require the

Figure 4 — Chart showing plate mill providing yields as calculated by the formula.



production of non-rectangular plates, sketch plates of irregular shapes, and circles. Before a provider can calculate slab weights for such product, he must first calculate the weight of the rectangular plates required to make the ordered shapes. Such calculations are conducive to providing errors. The tendency is to provide so as to insure against loss of product, and in most of the unusual instances not covered specifically by the table, providing losses are excessive and result in lowered yield.

PLATE PROVIDING — MULTIPLE STAND MILLS

The use of multiple-stand four-high mills for plate production has made many changes in providing requirements. Continuous slab heating furnaces have reduced scale losses, squeezers and edging rolls have made width control more accurate, continuous finishing trains have made it possible to roll long lengths, and the four-high mills have reduced gage variation or crown in the plates.

An attempt to correlate providing methods with the changed requirements is shown in Table II. Examination of the table will show that length is definitely an important factor. The reasoning followed in the case of ingot providing has been applied, and constant end-crop losses for a given plate width and thickness have been used, regardless of product length. On this basis, of course, yields increase as plate lengths increase. The table eliminates any variation in practice resulting from the different methods of specifying plate thicknesses, since the four-high mills are usually able to roll close to weight and to thickness at the same time.

While the method illustrated by Table II is a definite improvement over previous methods, it still has marked deficiencies. It still uses the theoretical plate weight as the basis for all calculations, and so perpetuates all of the disadvantages previously mentioned as attending the use of this weight. Furthermore, it forces the provider to interpolate almost constantly for sizes that are between the lengths and widths specifically tabulated, and in this instance again the tendency is always to use the higher providing loss allowance in order to assure production of the required size.

Further developments have indicated the need for supplying the mill roller and the provider with information regarding the amount of side scrap required for various plate sizes. Plates contract as they cool and the amount of scrap necessary for successful operation of side trimming shears must be related to the allowance made by the roller on the hot plate at the time the spreading passes are made. Theoretically, the amount of side trim required for successful operation of a shear should be constant regardless of width, but in practice it has been actually found that wider sizes require more stock because of the distortion encountered in spreading passes.

The determination of side scrap allowances for any given set of conditions is an important task and can have a marked effect upon mill yields. When slabs are rolled straight-away, or when spreading pass reductions are relatively light, modern squeezers and edging rolls make accurate and uniform width control possible, and in such instances the side scrap allowance need only be great enough to permit satisfactory mechanical operation of the shears.

When spreading passes are extremely heavy, the problem becomes somewhat different. Heavy reductions result in distortion of the slabs and the bars delivered from the broadside mill are elongated more in the center than they are at the ends. When such bars are turned 90 degrees for finishing in subsequent mills, they lack width uniformity. Heavy spreading passes also result in the delivery of thinner sections to the slab squeezer and to the vertical rolls. The combination of extreme widths, thin sections, and extreme width distortion, reduces the effectiveness of squeezers and vertical rolls, and in such instances the side scrap allowance must provide enough metal for satisfactory operation of the shears at the narrowest portion of the plate.

Figure 3 illustrates a typical schedule of side scrap allowance. The line "width as rolled" should theoretically be shown as a curve, but the step lines have been used for the provider's convenience. The use of a curve would necessitate constant reference to it, while the

TABLE II

Plate Providing Table for Continuous Mill

Sheared plate width	Percentage additions for plate lengths shown														
	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
24	34.6	29.2	27.5	26.5	25.0	24.4	24.0	23.5	23.3	22.8	22.7	22.5	22.4	22.2	22.0
36	28.3	23.6	21.4	19.9	19.0	18.5	17.8	17.6	17.2	17.0	16.8	16.6	16.5	16.2	15.8
48	26.4	22.5	19.8	18.2	17.2	16.5	16.0	15.7	15.5	15.3	15.0	14.9	14.7	14.5	14.3
60	25.0	20.5	18.4	17.0	16.3	15.5	15.0	14.6	14.3	14.1	13.9	13.7	13.6	13.5	13.4
72	25.0	20.5	18.4	17.0	16.3	15.5	15.0	14.6	14.3	14.1	13.9	13.7	13.6	13.5	13.4
84	24.5	20.0	17.7	16.5	15.4	15.0	14.2	14.0	13.6	13.4	13.2	13.1	12.9	12.8	12.7
90	23.6	19.3	17.2	15.8	15.0	14.5	13.9	13.4	13.3	13.0	12.9	12.7	12.5	12.2	12.0
96	23.5	18.6	16.8	15.1	14.6	14.0	13.5	13.3	13.0	12.7	12.5	12.3	12.1	12.0	11.8

Percentages indicated in the tabulation apply as additions to the theoretical plate weights.
Example: Plate size—¼ x 72 x 300 in. — 4 plates per slab
Theoretical weight one plate = 1530 lb — 4 plates = 6120 lb
Slab weight = 6120 + (13.9 x 6120) = 6971 lb

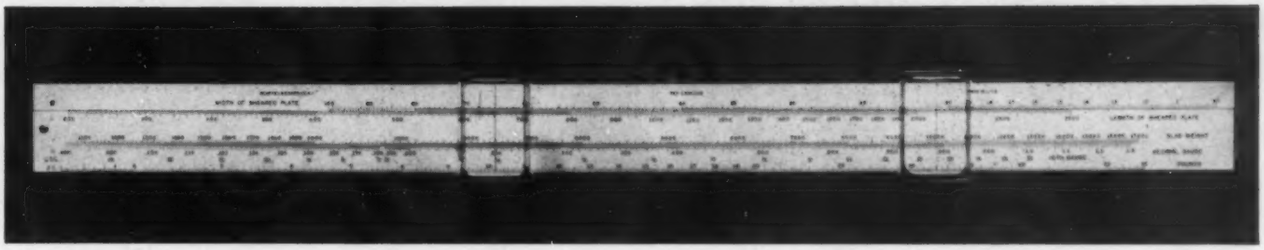


Figure 5 — A slide rule has been developed to simplify providing calculations.

step arrangement permits the use of a simple and convenient tabulation. In using such a tabulation, for example, if the sheared plate width is 45 in., the roller makes the hot-rolled plate 45 + 4.5, or 49.5 in. wide, and the provider can make use of this fact in this slab calculations.

Utilizing information gained from observations of scrap losses, while using a providing table similar to the one shown in Table II, a simple formula was devised for calculating slab weight requirements for various plate sizes, in this instance completely eliminating the use of theoretical plate weights as they appear on mill copies of the sales orders. This formula is shown below:

$$(W + S)\ (L + k)\ (T)\ (D)\ (K) = \text{Slab weight}$$

Where W = Finished width ordered by customer.
S = Side scrap — hot size.
L = Total length of plates to be produced from slab.
k = Constant allowance for end crops.
D = Weight of rolled steel per cu in.
(Plates = 0.2833)
(Sheets = 0.2910)
T = Ordered thickness.
K = Constant allowance for furnace losses, overweight and other variables.

Examination of the formula will show that (W + S) (L + k) (T) actually represents the volume of hot rolled steel delivered from the mill, including end and side scrap, the use of the density factor "D" converts volume into weight, and the use of the final K factor increases the weight to compensate for additional normal losses. The mill first using this principle found the following values to obtain:

$$k = 24 \text{ in.}$$
$$K = 1.03$$

Using these values, the formula for plates becomes:
$(W + S)\ (L + 24)\ (T)\ (0.2833)\ (1.03) = \text{Slab weight.}$

Providing yields have been calculated from slab weights obtained through the use of this formula and have been plotted in Figure 4. The curves show the marked effect of length upon yields, and indicate far higher potential yields than were ever considered possible with older providing methods.

Practical considerations, of course, make the use of the formula too cumbersome for repeated manual calculations. To simplify the calculation, a special slide rule has been developed by Carl E. Schlossnagle, assistant superintendent of the 100 in. plate mill at the Homestead Steel Works. By its use, rapid and accurate slab calculations can be made without losing any of the advantages attached to the use of the formula.

Figure 5 shows this rule. It is equivalent to a standard 16 in. slide rule with special features to facilitate the slab calculation. The top scale "W" represents plate width. Since side scrap allowances vary for different widths, and since they may require revision from time to time, the side scrap allowance has not been built into the rule. The provider must add the required side scrap allowance to the ordered plate width and then set the slide rule indicator to the total or overall hot-rolled width.

Scale "L" represents the total length of product to be obtained from the slab. Since the factor k = 24 is a constant for the mill involved, this factor has been built into the scale. A setting of 1200 in., for example, is actually equivalent to 1224 in. on a standard logarithmic scale. This, of course, eliminates the need for a mental addition on the part of the provider.

Scale "P" represents slab weight. In transferring from the top to the bottom set of scales, the factors (0.2833) (1.03) or (0.2910) (1.03) are automatically introduced into the calculation.

Scale "G" represents plate (or sheet) thicknesses in decimal equivalents. It will be noted that this scale shows a gap at 0.1875 in. Gages lighter than this are considered as sheets and the gap is necessary to compensate for the fact that the accepted figure for plate density is 40.8 pounds per square foot, and the accepted figure for sheet density is 41.92 pounds per square foot.

Scale "USS" represents United States standard gage numbers from No. 13 to No. 7. Beyond No. 7, the figures refer to fractional inches, in sixteenths.

Scale "WT" represents weights per square foot. Since many plate orders are entered with the thicknesses specified in terms of weight per square foot, this scale eliminates the need for converting these values into decimal equivalents prior to making the providing calculations.

Figure 6 shows the rule set for a typical calculation:
Assume plate size — 4 pieces $\frac{5}{16} \times 72 \times 300$ in. — side scrap = 6 in.
Set left hand indicator to 72 + 6 = 78 in.
Move slide to 1200 = (300 × 4).
Under right hand slide above 5 = $\frac{5}{16}$ in. read slab weight 8,700 lb.

In some instances the factor K = 1.03 may be insufficient. This is true in instances where arbitrary overall scarfing is done because of quality considerations, or in instances where specifications require that plates

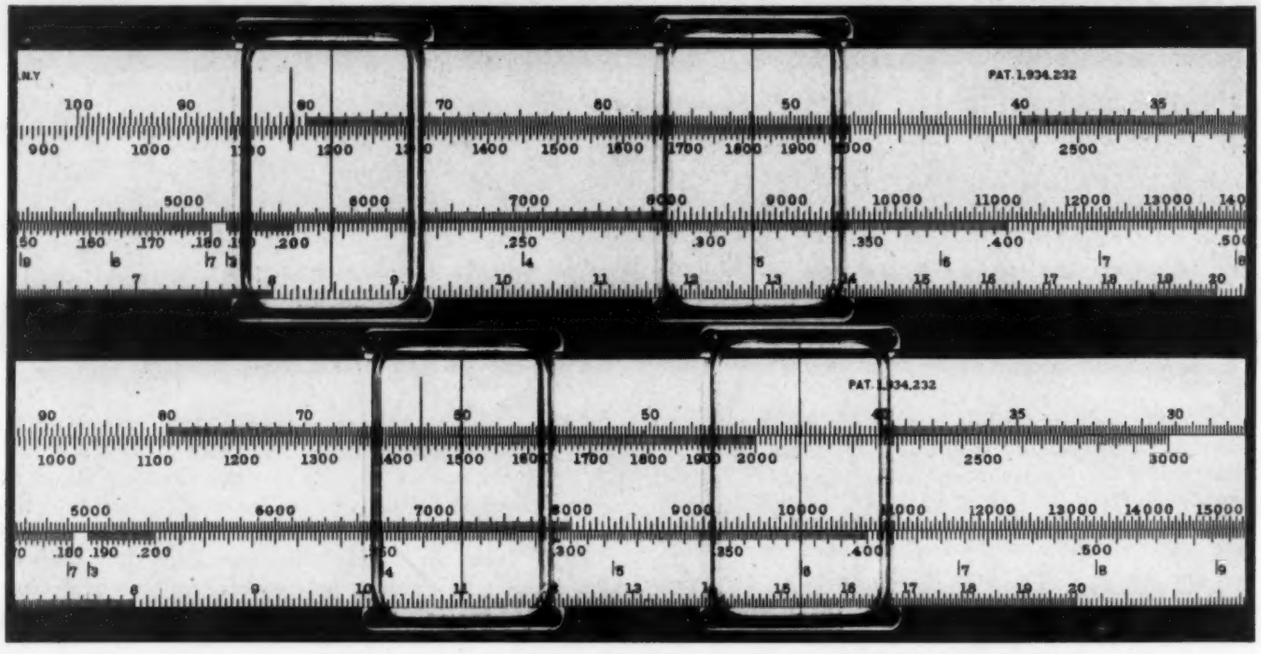


Figure 6 — Providing slide rule set for typical calculation.

Figure 7 — The left hand slide has a double line to allow for an increased "K" factor.

be rolled heavy. One method of increasing the value of "K" is illustrated by Figure 7. The left hand indicator glass has two indicator lines separated so that moving from one to the other is equivalent to 4 per cent. The use of this additional line in effect increases K to 1.07. Experience has shown, for example, that mill edge plates require more than normal provision, and in one instance the additional provision requirement is 4 per cent. The following example illustrates the method used for calculating slab weights to be rolled into unsheared mill edge product:

Assume plate size: 4 plates $\frac{3}{8} \times 60 \times 360$ in. mill edge, no scrap allowance.

Set left hand indicator glass (main hairline) to 60 in.

Move slide so that 1440 (4×360) falls under supplemental hairline.

Under right hand slide above 6 = 6/16 or $\frac{3}{8}$ in. read slab weight = 10,000 lb.

The particular values used for K and k may vary in different mills, and these values can be determined only by field observations. Supplemental hairlines representing values greater or less than the 4 per cent used in the illustration, can be added simply by etching new markings on the indicator glass.

SPECIAL APPLICATIONS

While the slide rule method of provision was developed originally for calculating slab weights for product rolled on multiple-stand four-high mills, its flexibility permits its use in other types of mills. One single-stand universal plate mill is using the same rule by increasing K to 1.07 in the manner previously described, and one single-stand four-high mill has used the principle to advantage on heavier product by using K = 1.07 and by increasing k from 24 to 33 in.

The slide rule is especially valuable for use in cases where irregular widths are involved. In the case of sketch plates, the procedure is the same as for rectangular plates, the rule being set for the widest, or the longest portion of the sketch plate, and the intermediate procedure of calculating an estimated weight for the rectangle required to make the sketch is eliminated. In providing circles, the diameter plus the required side scrap is used as the plate width, and the diameter plus the necessary clearance between units is used as the unit length for computing overall lengths. In providing small miscellaneous items, it is frequently necessary to produce more than one width from a given slab. In such instances, the width of the widest plate is used for the slide rule setting, and the balance of the calculations remains the same. This again eliminates an intermediate calculation necessary under previous methods in order to convert the narrower sizes to equivalent weights at the width of the widest size.

Mills using the providing methods as outlined in this paper have found many resulting benefits. The simplification of calculations has greatly reduced mill losses attributable to clerical errors. The use of specific providing rules and methods has reduced losses resulting from errors in judgment, and at the same time the available data have been put into usable form so that a provider can make use of known facts in his daily work. By proper use of the available tools, a provider can now provide the maximum possible yields for any given set of mill conditions. In all instances where the methods described here have been used, mill yields have shown definite upward trends, and production rates and costs have shown parallel improvements.

A Modern Eectric Furnace Installation

. . . . with the growth of demand for steels of high quality and high alloy content, electric arc furnaces developed from small auxiliaries stuck in a corner of the plant into modern production units . . . .

by Frank W. Brooke and Henry K. Georgius

SWINDELL-DRESSLER CORPORATION

PITTSBURGH, PENNSYLVANIA

▲ AS a part of the general war expansion program of the steel industry, a new electric steel plant was built in 1943 at Homestead, Pennsylvania for the production of alloy steel. As shown in Figure 1, this plant consists of two adjoining bays, one of which contains the melting and forging shop, and the other a heavy machine shop for finishing the forgings. The two bays are separated by a wall so that they form, in effect, two separate shops. This paper will deal with the melting shop.

The figure illustrates the straight-line flow of material on which the plant layout is based. The scrap enters at one end of the building where the scrap storage is located. Then follows in order down the length of the shop, the electric melting furnaces and ingot pouring station, the ingot heating furnaces, the hydraulic forging presses, and the storage for completed forgings. Space is also provided for a brick storage and a maintenance shop.

Figure 2 shows the general arrangement of the melting unit, which is built around two 17 ft-0 in. diameter electric melting furnaces, each of which has a capacity of 55 to 75 tons, and is powered by means of a 10,000 kva transformer.

The straight-line-flow through the plant is illustrated in this figure also. Scrap is brought into the building in railroad cars at one end of the shop. It is unloaded by a crane magnet from the cars into the concrete scrap storage bin which is sunk below floor level. This bin is divided by walls into separate compartments in order to permit proper segregation of the scrap, although this is not shown in the illustration.

This storage system has the important advantage of keeping the scrap dry, and protecting it from freezing temperatures in the winter. Serious explosions can result from pieces of ice in the charge, or even from wet scrap, especially on recharging. Aside from this obvious hazard, the presence of moisture in any part of the charge produces hydrogen in the steel. There is a definite emphasis being placed on keeping all water in any form out of the furnace for this reason.

In a compartment in one corner of the scrap bin is located the scrap scale, the platform of which is level with the bottom of the bin, while its beam is on the level of the shop floor. Mounted on the scale platform is a device which automatically closes the leaves of the charging bucket as the bucket is lowered onto the scale.

Next in line are the two top charge electric melting furnaces which are arranged to pour into a common pit. A unique feature of this pit is that it has been enlarged beyond the usual practice in order that it may also contain the ingot molds. This arrangement reduces considerably the distance which the ladle has to travel from the furnace spout to the mold.

On the slagging side of each furnace is a slag pit of ample dimensions provided with a bricked-in cover which is so arranged that it can be picked up with the crane magnet. In this way all projections and loose rings are avoided, and a clear working floor is assured.

In each of the slag pits is located a large, cast slag ladle of the conical type, approximately 10 ft-0 in. in diameter. Each ladle is provided with a permanently attached bail for lifting it out of the pit.

The slag ladles are sufficiently large and are so located that the amount of slag that misses them during slag-off is very, very small. At regular intervals, this small accumulation is cleaned out. In fact, throughout the entire plant, cleanliness and good housekeeping are emphasized.

Along the near wall of the shop, which is cut away in the illustration, there are the necessary storage bins for bottom material, lime, silica, spar, ferro alloys, etc.

Further down the shop, off to the left of the illustration, are located the heating furnaces and hydraulic forging presses, and at the far end of the shop there is provided ample storage space for storing the completed forgings.

The straight line flow of materials from the entering

Presented before Cleveland Session of AISE Annual Meeting, September 24, 1945.

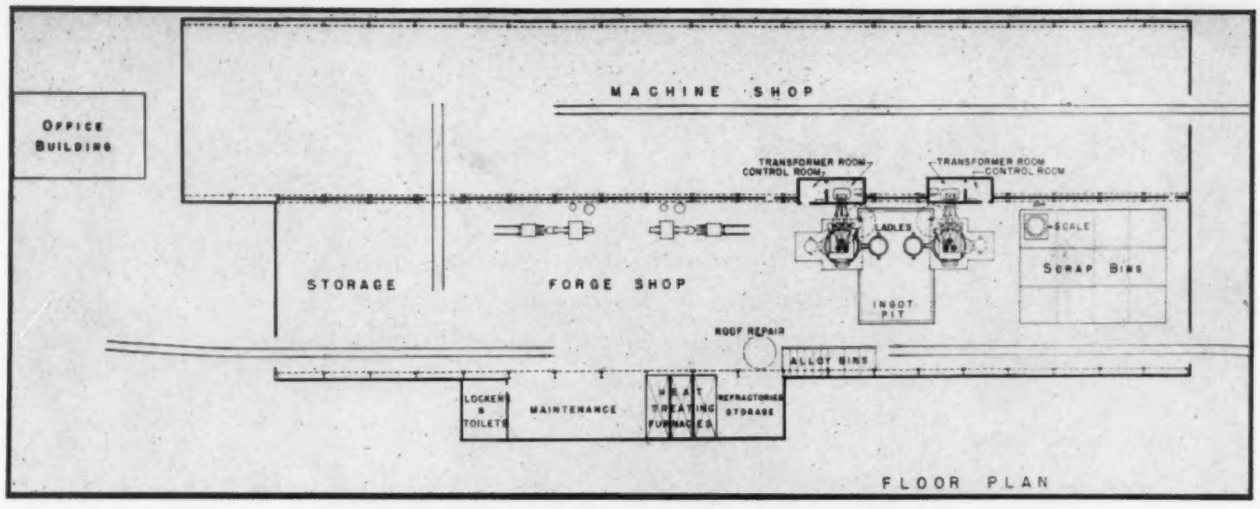


Figure 1 — Layout of new electric steel plant built in 1943 for the production of alloy steel.

scrap to the completed forgings assists in producing maximum output with minimum confusion. It will be seen from the illustration that ample floor space and overhead clearance have been provided. These, together with a large window area, provide pleasant working conditions and allow room for possible future additions to the equipment.

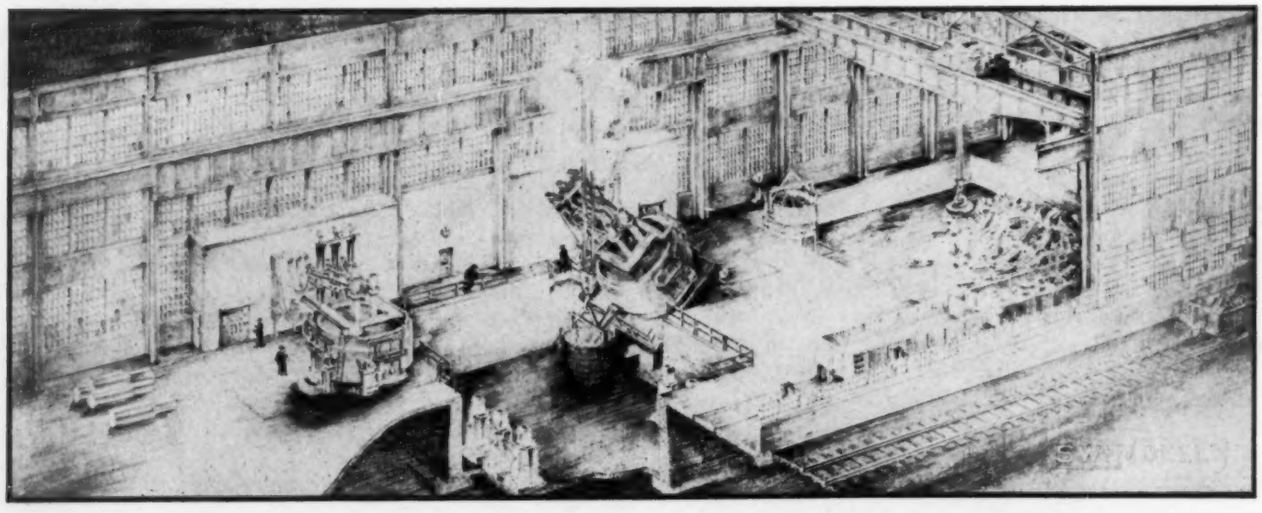
Figure 3 shows the two electric furnaces in greater detail. One of the unique features of these furnaces is that each shell is a one-piece steel casting with an inside diameter of 17 ft and an overall height of approximately 11 ft. Cast integral with the furnace body is a water jacket which completely surrounds it and extends from the sill level up to the parting line of the roof. The square patches visible are the core print openings by means of which the core which formed the water jacket was held in place. These openings were closed by welding in steel plates after which the water jackets were tested under pressure and found to be perfectly sound.

In order to minimize the water consumption on furnaces so liberally provided with water cooling as these, a special system for re-using the water was developed. This consisted of first using the water for cooling the transformer and certain vital parts of the furnace such as the electrode holders, electrode arm copper, and the water-cooled flexible cables. The drainage from these was then collected and reused for cooling the doors, door frames, roof ring and the water jacket around the shell.

The liberal use of water-cooling has been well justified by the increase in refractory life which averages 270 heats for the sidewall in basic practice when making alloy steels.

Figure 4 shows a section through the lining of either of these furnaces. The brick in the furnace bottom is magnesite, up to about the sill line. From there on up to the parting line of the roof, the sidewalls are lined

Figure 2 — The general arrangement of the melting unit is built around two 55-75 ton electric furnaces.



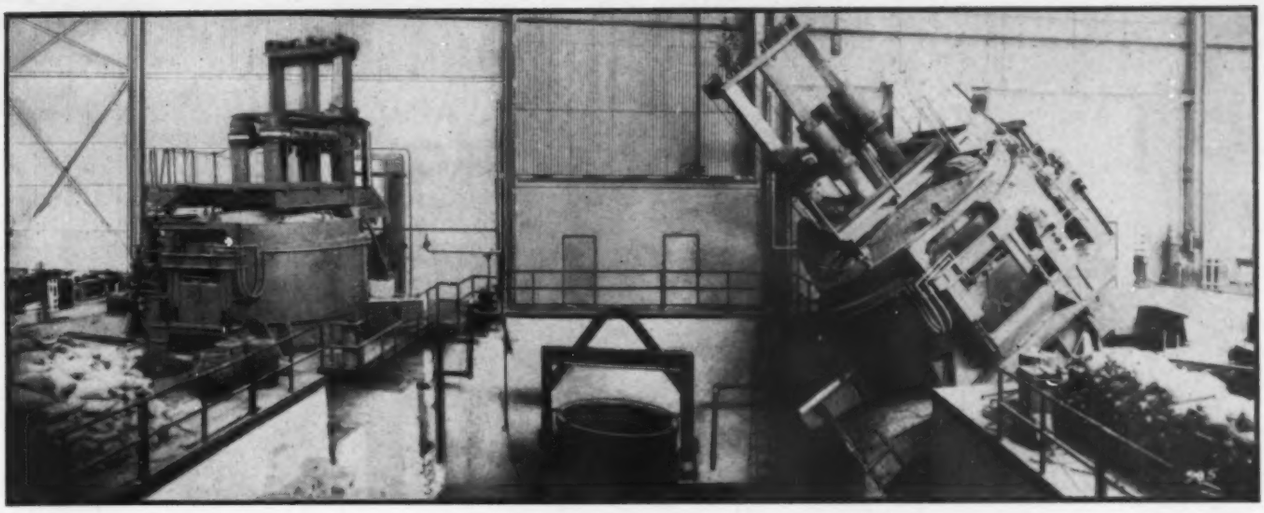


Figure 3 — The shell of each furnace consists of a one piece steel casting.

with metal-case brick, using 13½ in. standard shapes. The roof is laid up of silica.

In laying up the sidewalls and particularly the roof great care is taken to provide the correct amount of allowance for expansion and to have this uniformly distributed. For a silica roof this amounts to approximately 3/16 in. per foot in all directions. However, this is not by any means a fixed and definite figure. Each roof is more or less a law unto itself so far as expansion is concerned. The important thing is that the correct expansion allowance of so much per foot was determined by trial and was distributed uniformly over the entire roof area. If this is not done, if the expansion joints are bunched together, the roof is sure to warp and go out of shape as it heats up. This usually means trouble at the electrode ports.

The bottoms of these furnaces are rammed in with "Ramix." If properly applied and properly cured, such a bottom seems to give excellent service. Originally these furnaces were provided with burned-in bottoms of dead-burned magnesite. These did not give the good service that is usually expected of a burned-in bottom and they were torn out and replaced.

As shown on Figure 5, the furnaces are of the swinging roof type. In each of the furnaces the roof is supported at four equally spaced points from two beams extending from a rugged steel casting. In this way the stresses in the roof ring and in the roof brick are reduced to a minimum.

The steel casting which carries the roof beams also carries the electrode masts and winch mechanisms. The construction is clearly shown in Figure 6, which illustrates the method of mounting the winches on a platform attached to the roof support casting. It can readily be seen that this construction reduces to a minimum the length of steel cable necessary and eliminates a great many sheaves and compensating devices. It keeps the winches and steel cables up and out of danger from damage due to run-outs and makes the entire mechanism more accessible for maintenance.

Figure 4 — Section through 17 ft 0 in. diameter electric melting furnace.

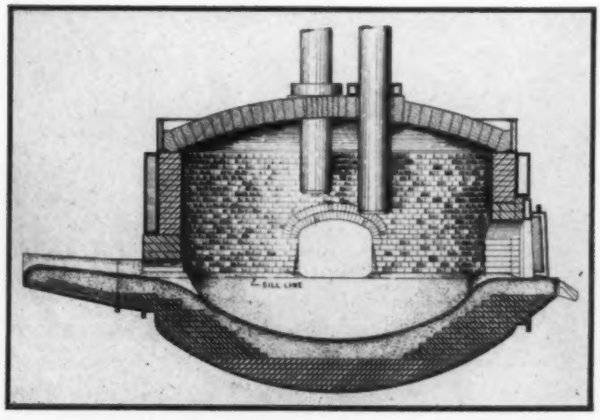
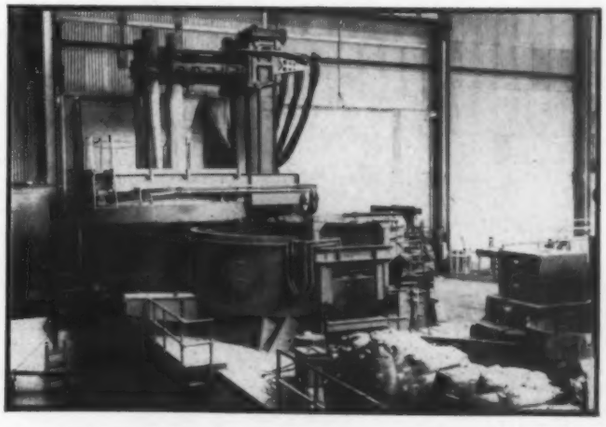


Figure 5 — The furnaces are of the swing roof type and top charging is used.



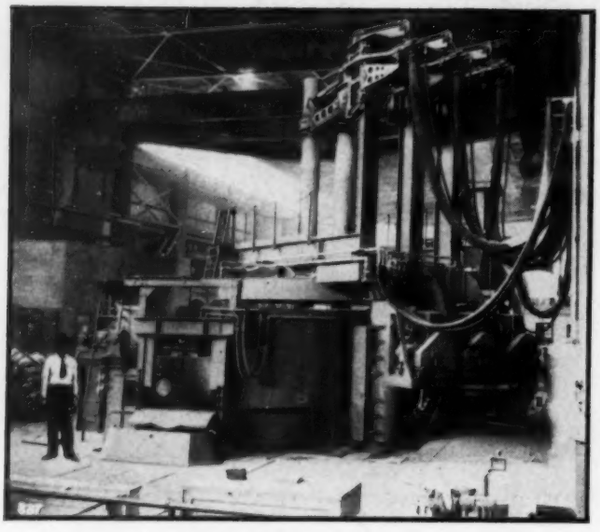


Figure 6 — The method of mounting the winches reduces to a minimum the length of steel cable necessary.

Finally, it simplifies the foundation by eliminating all underground channels and chambers otherwise provided to accommodate the steel cable or winches.

The entire roof, mast and winch assembly is mounted on the vertical ram of a rugged hydraulic cylinder which can be seen in the illustration and which is permanently attached to the furnace shell. This cylinder also carries a cross-piston by means of which the roof is swung open and shut. By this construction, permanent alignment between the roof and the furnace body is assured and all manually-operated roof clamps are eliminated.

Down the back of each mast will be seen a series of notches. In the event of failure of one of the steel cables, an automatic catch on the electrode crosshead enters one of these notches and prevents dropping of the electrode into the furnace. This automatic device prevents splintered electrodes and damaged electrode arms.

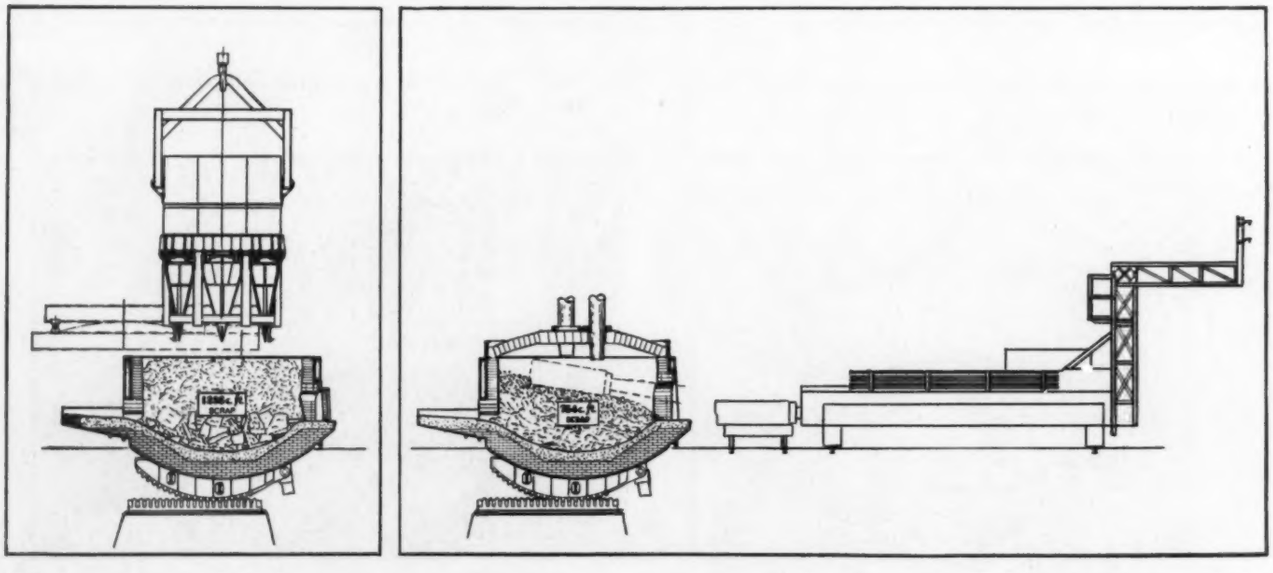
For large furnaces such as these, top charging has definite advantages. One of these, illustrated in Figure 7, is the ability to fill the furnace completely with scrap, thereby greatly increasing its useful scrap holding capacity. The amount of scrap which can be charged into a furnace with a charging machine is only about 60 per cent of the amount which a top charge furnace of the same dimensions will hold.

Another advantage is in reducing to a minimum the "down time" between heats. Figures 8 through 13 inclusive, taken from this particular installation, illustrate the various steps which take place between "power-off" and "power-on."

At the end of the heat the furnace is tilted and the steel tapped into the ladle, Figure 8. After the furnace has been completely drained, it is returned to the level position and the bottom is thoroughly examined for areas requiring patching, Figure 9. When necessary, bottom material is carefully thrown in or placed with a spoon. As soon as the bottom has been completely repaired, the electrodes are raised to the tops of the masts, Figure 10, and the roof is then raised and swung open, Figure 11. In the meantime, the loaded charging bucket has been picked up by the crane. It is now brought over the furnace and lowered into it to allow the tie rope to burn off, Figure 12. This takes approximately one minute in a hot furnace. As soon as the bucket has opened, it is withdrawn from the furnace, Figure 13, and replaced on the scale platform. The roof is then closed and the power turned on.

An interesting method is used in this plant to expedite rapid charging. While the bottom is still being repaired and before the roof is opened, the loaded bucket is picked up by the crane. The bucket is then lined up with one of the center-lines of the furnace by sighting

Figure 7 — Top charging enables one to fill the furnace completely with scrap.



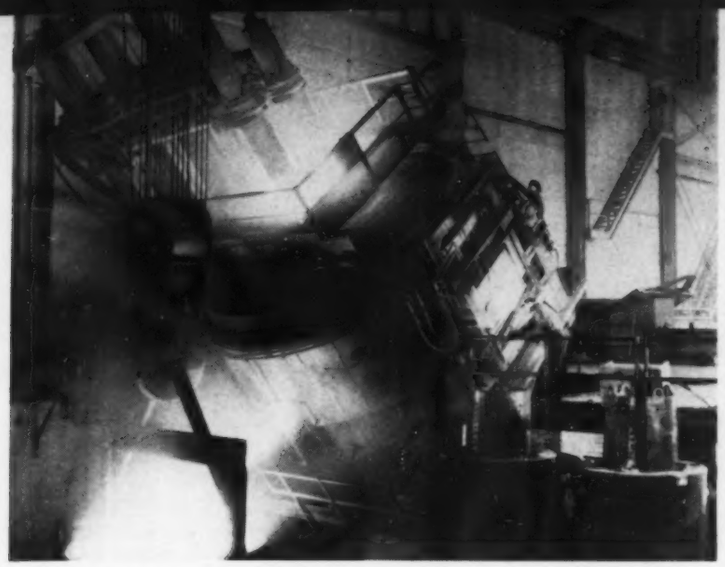


Figure 8 — At the end of the heat, the furnace is tilted and the steel tapped into the ladle. After the furnace has been completely drained, it is returned to the level position and . . . .

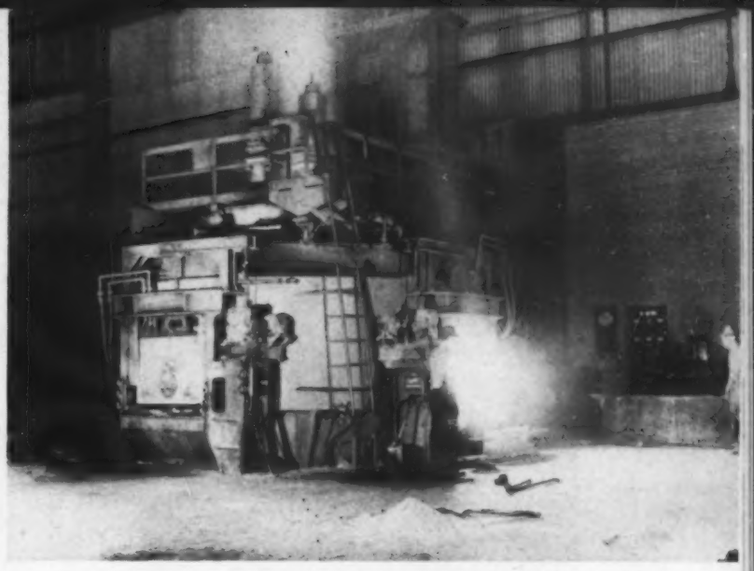


Figure 9 — . . . . the bottom is thoroughly examined for areas requiring patching, and the bottom material is carefully thrown in or placed with a spoon. As soon as the bottom is completely repaired . . . .

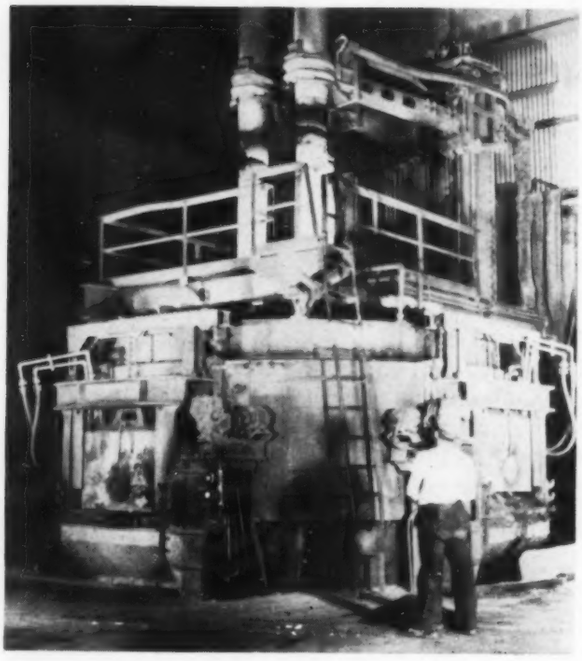


Figure 10 — . . . . the electrodes are raised to the tops of the masts. Then . . . .

Figure 11 — . . . . the roof is raised and swung open. In the meantime the loaded charging bucket has been picked up by the crane. It is now brought over the furnace and . . . .

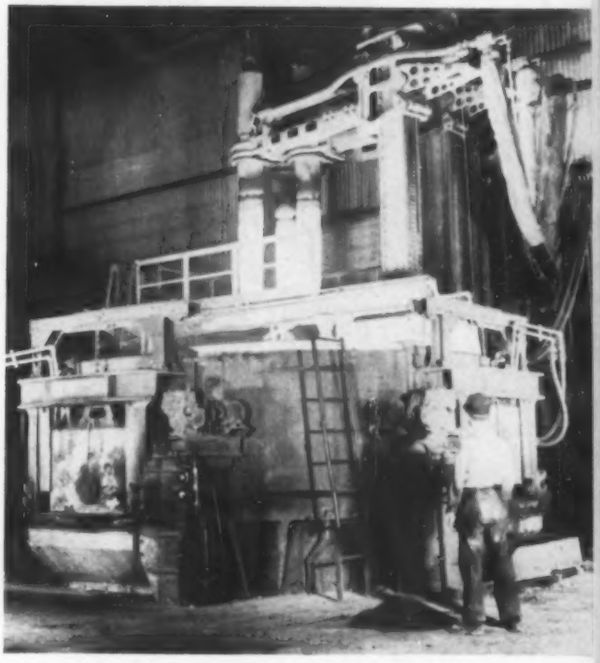


Figure 12 — . . . . lowered into it to allow the tie rope to burn off. As soon as the bucket has opened . . . .

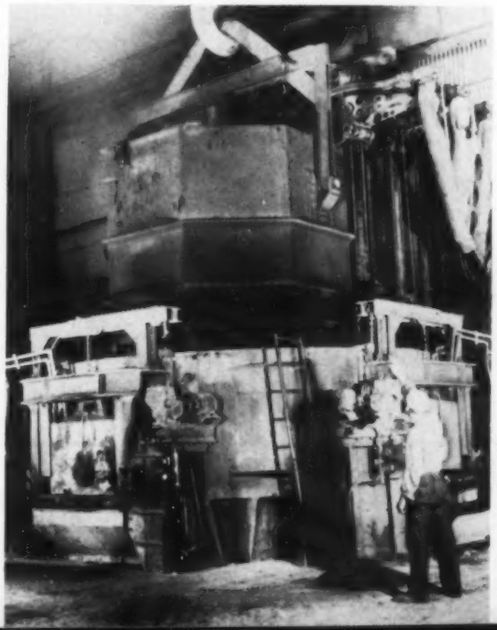
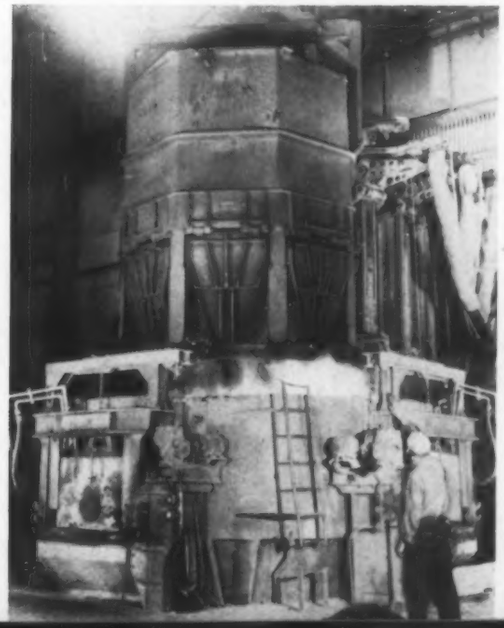


Figure 13 — . . . . it is withdrawn from the furnace and taken back to the loading station. The roof is then closed and the power turned on.



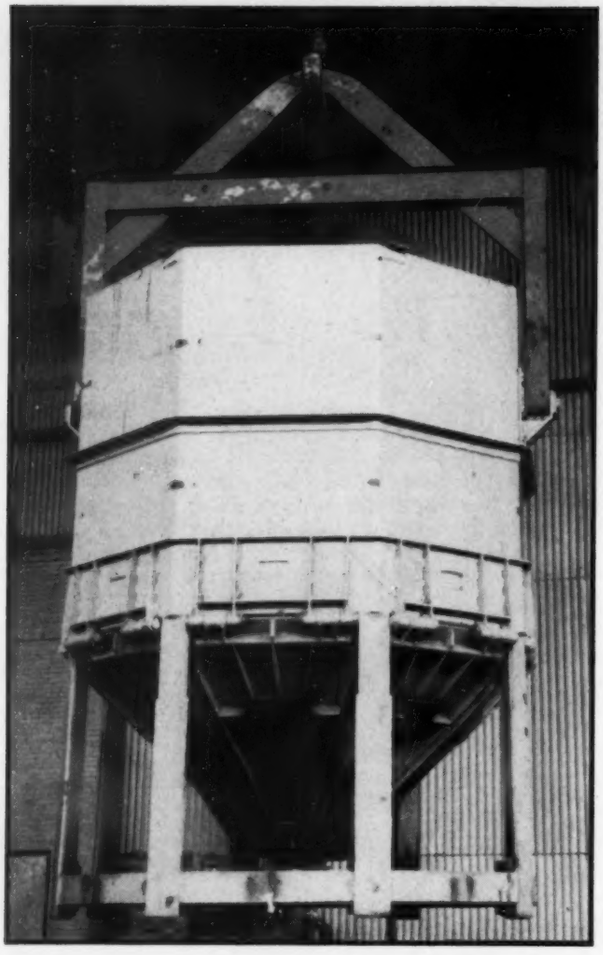


Figure 14 — The design of the charging bucket is rather unusual.

on a mark on the building wall. This saves time in centering the bucket over the furnace, since the crane then needs to be moved in only one direction.

In this particular plant the total time from "power-off" to "power-on" averages approximately 12 minutes, and has on quite a number of occasions been as low as eight minutes.

Such excellent results in the "down time" between heats is due in part to excellent organization, in part to keeping the furnace bottom continually in first-class shape, and in part to the design of the special charging bucket by means of which the entire charge can be placed into the furnace at one time so that recharges are unnecessary. The charge usually is between 110,000 and 120,000 lb, but has on occasion been as high as 154,000 lb. For the 154,000 lb charge selected scrap was used.

The charging bucket is shown in detail in Figure 14. It is of novel design, being octagonal in cross-section and provided with a tapered bottom. This construction allows the bucket to be a "close fit" in the refractory lined furnace shell, and results in minimum disturbance when the bucket opens.

As a result, the charge levels off well when released from the bucket. Equally important is the fact that the furnace can be charged in the bucket. In other words, the melter can have the charge placed in the bucket in the order in which he wants it in the furnace. For example, the heavy scrap is placed in the bottom of the bucket, the intermediate scrap next and the light scrap on top. Then, after the bucket has opened, the melter can have complete assurance that the charge will lie in the furnace in the same order as it did in the bucket.

It is of interest to note that on several occasions, pieces as large as 33 in. in cross-section, 110 in. long and weighing approximately 20,000 pounds have been bucket-charged into the furnace as a part of the regular charge without any damage to the refractories.

Figure 15 shows the scrap scale with the automatic bucket closer. As has already been mentioned, the scale platform is located in the bottom of a compartment of the scrap pit, while the scale beam is on the shop floor level.

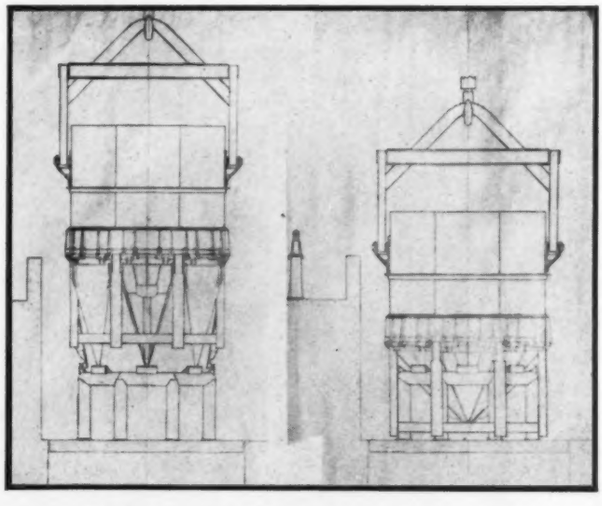
The view on the left shows the leaves of the bucket just entering the automatic closing device. This consists of a welded octagonal framework of 10 in. pipe bolted to the scale platform and provided with guides which automatically close the bucket leaves as the bucket is lowered.

The view on the right shows the bucket fully lowered onto the scale platform. The eight leaves have been completely brought together. The tie-rope is then wound around the hooks at the ends of the leaves and tied.

The tare of the scale is set to include the weight of the bucket and the bucket closing device, so that the scale beam indicates the net weight of the charge.

When it is considered that the furnace time is frequently valued at $100 or more per hour, it is easily seen that a saving of even 10 to 20 minutes in charging time means quite a little per ton of steel. Since large furnaces such as make up this installation have an output of 5500 to 6500 tons per month, the result is a yearly saving of somewhere around $30,000.00 per furnace. A considerable investment can be justified on this basis.

Figure 15 — On the left is seen the charging bucket just prior to closure, and on the right, the bucket is fully closed.



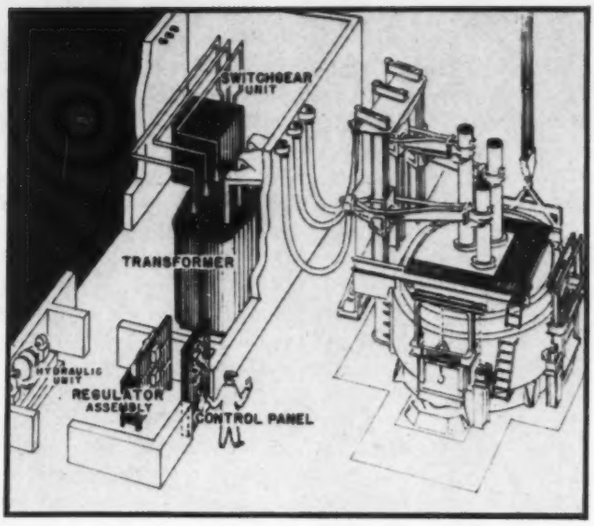


Figure 16 — Schematic view of electric equipment for furnaces.

Figure 16 shows schematically the arrangement of the electrical equipment for such an installation. It can be seen that the sub-station is divided into two separate rooms. The high-tension room contains the switchgear unit and transformer, while the low-tension room contains the regulator assembly and the control panel built in the wall at a location convenient to the furnace operator. The hydraulic power unit is also generally located in the low-tension room.

One of the transformers used in this particular installation is shown in Figure 17. It has a rating of 10,000 kva at a high tension voltage of 11,000 volts and is provided with taps by means of which ten secondary voltages may be obtained, ranging from 290 volts down to 110 volts. A four-position motor-operated tap changer is provided to make any four of these voltages available to the furnace operator.

This transformer differs from the majority of those used for arc furnace service in that it is of the water-cooled, forced oil circulated type. Since this installation was made at a time when transformer materials were on the very critical list, every effort had to be made to conserve these as much as possible. By use of the forced oil-cooled design, it was possible to build this transformer with a considerable saving of copper and iron as compared to transformers of the usual oil-insulated water-cooled type.

The figure shows the external oil cooler through which the oil is circulated by means of two motor driven oil pumps mounted on the side of the transformer case. The oil cooler is of the tubular design in which the oil is cooled by water circulating through tubes.

The oil circulating pumps are completely enclosed and arranged with their driving motors immersed in oil thereby eliminating all stuffing boxes and all chances for leakage. Each pump is of sufficient capacity to take care of the entire cooling requirements of the transformer, so that in the event one pump fails, the transformer can be operated with the other pump alone. Not only do the pumps force the oil through the external coolers, but by means of ducts built into the transformer itself, a rapid flow of oil is directed through the core and coils by means of which more efficient heat transfer in the transformer is accomplished. It was chiefly this feature which resulted in the saving of critical materials.

At least one of the electrical manufacturers is ready to offer transformers of this design for peace-time installations. They would make just one change and that is to make the cooling water pipes in the oil cooler out of copper. During the war these had to be made of steel, because of Government restrictions on the use of copper.

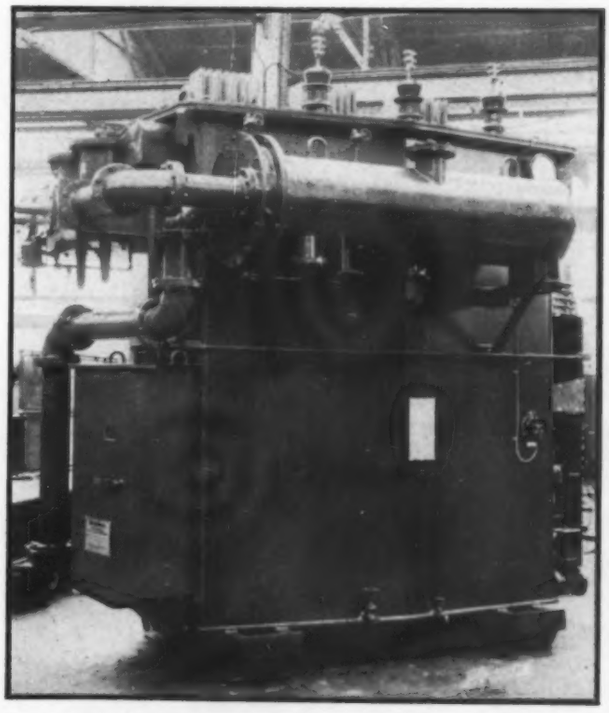
The maximum current in the secondary leads of these furnaces is of the order of 30,000 amperes per phase. Such high secondary current required considerable study during the designing of the furnace to avoid the evils of inductive effects. In Figure 18 can be seen how the secondary conductors were split to pass around both sides of each electrode mast, so that the magnetic field in the mast is practically nullified by the opposing effect of the field due to each half of each phase. In order to avoid any possibility of magnetic induction, the electrode arms and the electrode cross-heads were made of non-inductive alloy.

Figure 19 is a plan view of the sub-station of this installation. As was previously mentioned, the sub-station is divided into a high-tension and a low-tension room. In the high-tension room are located the transformer which has already been described, and the air circuit breaker.

The air circuit breaker in this particular installation has a capacity of 600 amperes and a voltage rating of 15 kv. Its interrupting capacity is 250,000 kva. It is especially designed for arc furnace service to withstand the frequent operations which are encountered in such service.

In recent years the manufacturers of electrical equip-

Figure 17 — The transformers are rated at 10,000 kva at 11,000 volts.



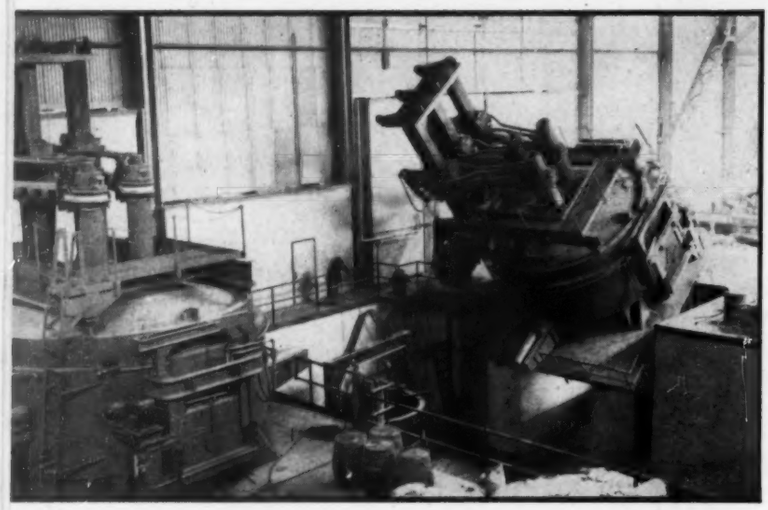


Figure 18 — The high secondary currents necessitated designing the conductors to minimize inductive effects.

ment have begun to attack the problem of building circuit breakers which are mechanically rugged enough to be reliable in furnace service. In ordinary power service, a circuit breaker may be called upon to operate anywhere from a very few times to perhaps 1,000 times per year. On the other hand, it is not at all unusual for a circuit breaker in arc furnace service to operate as frequently as 50,000 times a year. When a circuit breaker on general power service does operate, however, it is frequently to interrupt overload currents, whereas an arc furnace circuit breaker is primarily used as a switch and is generally required to open only the full load current or the magnetizing current of the transformer.

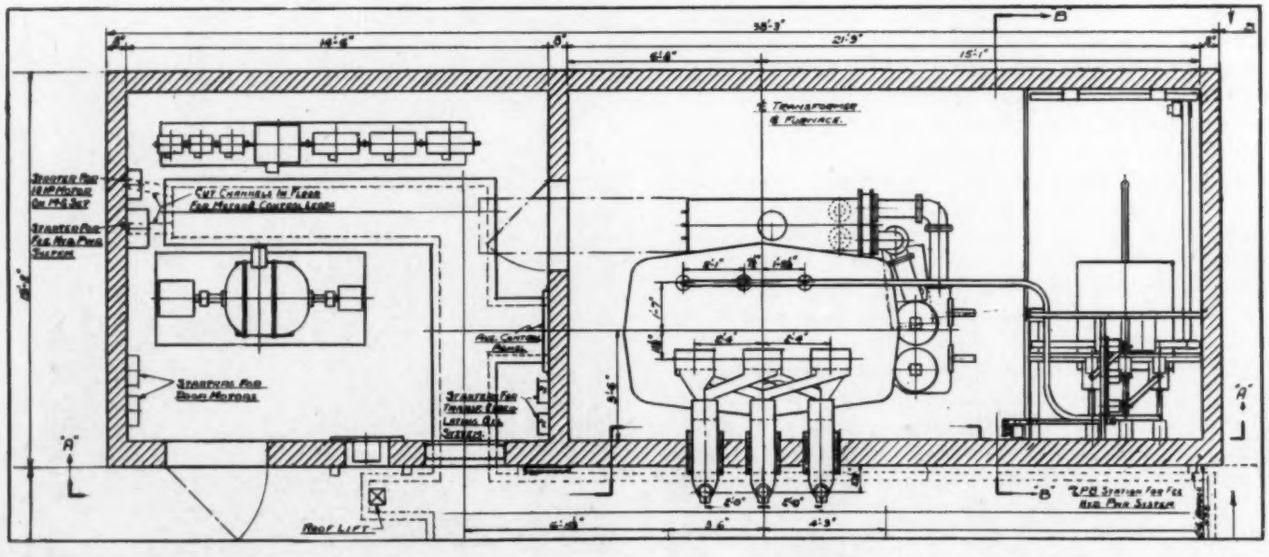
The result is that an arc furnace breaker is called upon to perform a different service from a power breaker, and its mechanical ruggedness is of prime importance. In all too many cases it has been a mechanical breakdown of the operating mechanism which has caused a serious accident to the breaker.

The electrode regulator will be seen at the rear of the low-tension room. This is of the rotary variable voltage type, and in this particular installation it consists of a single motor driving three exciter units and three generators, all seven units being in a straight line. An alternative arrangement which is used by some manufacturers of this type of equipment is to have three independent units, one for each phase, and each self-contained with its motor and generator. There is some disagreement as to the relative merits of the two designs, but the industry appears to favor the design based on three independent units.

Since the rotary variable voltage regulator was first introduced, there has been considerable discussion as to savings in time and in power consumption. To date there does not, as yet, seem to be any real agreement on this subject. Some operators have found improved power consumption and melting time with the use of the rotary regulator as compared to the contactor type, while others report that so far as they can see, the rotary regulator provides very little advantage along this line. Undoubtedly, the particular practice followed has a bearing on this.

There does appear to be, however, agreement on the subject of maintenance. The rotary regulator provides much smoother electrode operation with considerably less wear and tear on the mechanical portions of the electrode mechanism. There also appear to be fewer maintenance problems and lower maintenance costs with the rotary regulator itself as compared to the balanced beam regulators. The general consensus seems to be that maintenance costs of the electrode regulating system are lower with the rotary regulator than with the contactor type.

Figure 19 — Plan view of sub-station.



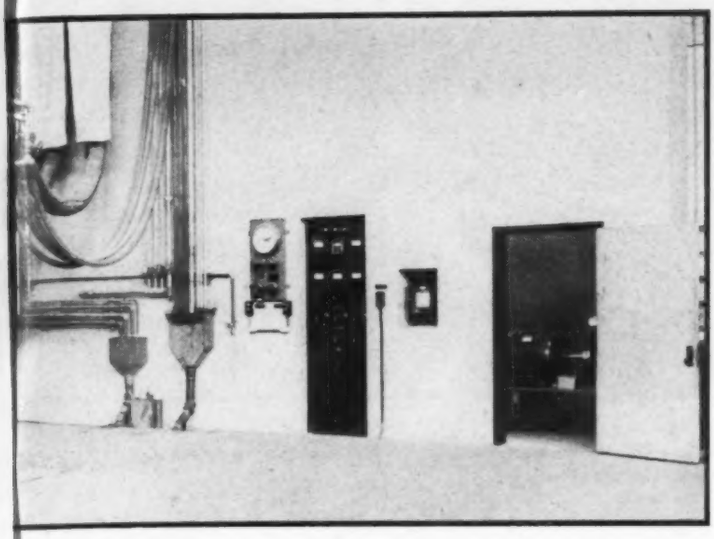


Figure 20 — The operator's control panel is built into the front wall of the low-tension room.

In the center of the low-tension room will be seen the hydraulic power unit which furnishes the necessary oil pressure for operating the furnace roof and for tilting the furnace. It consists of an oil reservoir on which are mounted two oil pumps, together with the drive motor. The two pumps are provided in this particular installation because one is sufficient to operate the roof, but two are required in order to get the desired tilting speed. Automatic valve arrangements were installed so that the pressure on one pump is relieved while the roof is being operated.

By means of other automatic valve arrangements the tilting of the furnace is interlocked with the roof operation. The lifting and swinging of the roof are also interlocked so that the roof cannot be swung unless it is in the fully raised position.

Built into the front wall of the low-tension room is the operator's control panel. This is shown in Figure 20. It contains the usual instruments and controls, which include the secondary voltmeter, watt meter, watthour meter, 3 ammeters, electrode rheostat and control switches, controls for the circuit breaker and tap changer, as well as starter buttons for the rotary regulator. To the right of the main control panel will be seen a graphic watt meter which is being installed in quite a number of large installations to provide better records of the heats, in order to make possible studies for improving the practice. Through the open doorway can be seen the hydraulic power unit which has already been referred to.

To the left of the main control panel is located an auxiliary panel on which are mounted a synchronous clock, a set of alarm bells and lights, and, perhaps most important of all, the thermometer dial which indicates the temperature of the oil in the transformer. All too often this thermometer is mounted high up on the transformer case in an inaccessible location where hardly anyone ever looks at it from one day's end to the next. These thermometers can be obtained with flexible tubing of sufficient length so that they can be mounted at a location where the furnace operator can keep a continual check on the oil temperature of the transformer. If this is done, the melter will be in a much better position to anticipate any transformer trouble before it becomes serious.

During the period of planning which preceded the actual construction of the plant, the various types of electric melting furnaces and the various shop arrangements were carefully investigated.

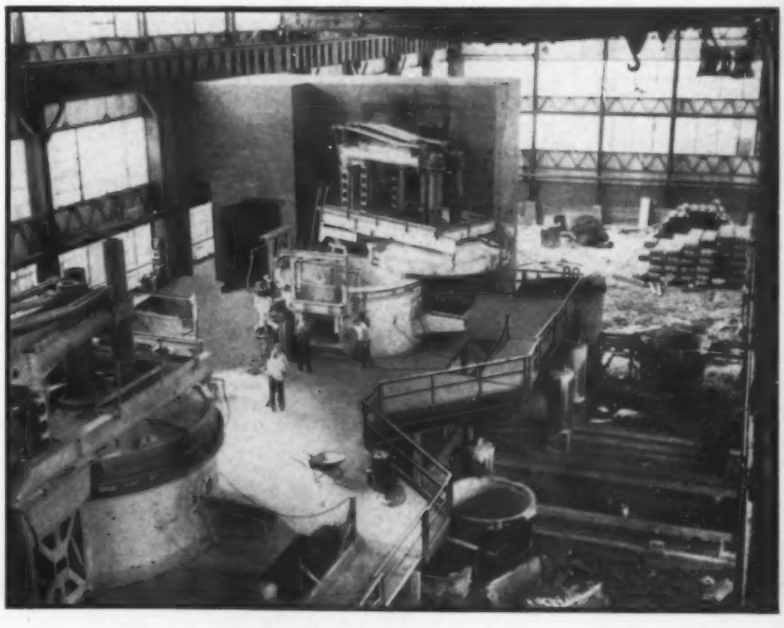
The operating company had been making steel in a 25 ton, door-charge electric arc furnace of their own for the past eight years. The pros and cons of top charge versus door charge furnaces were fully discussed and the choice was made in favor of the top charge design for the furnaces in the new plant. Operating economies have proved this choice to be the correct one.

In addition to economy of operation, another factor which influenced the choice in favor of the top charge furnace was the floor space required for the two types of furnaces. This is illustrated in Figure 7 which shows that a door charge furnace with its charging machine ties up a considerably greater amount of floor space than a top charge furnace.

The question of platform mounting versus floor mounting of the furnaces was also considered. Figure 21 shows a typical installation of two large top charge electric arc furnaces mounted on a platform. One important difference between the two types of installation is the difference in the amount of headroom required. The platform arrangement requires a building eight to ten feet higher than the floor mounted arrangement. In addition, the cost of the platform adds to the overall expense.

Figure 22 shows an interesting view into the top of one of the furnaces shown in Figure 21. The roof has been swung open to reveal a molten bath of approximately 40 tons in the furnace. The slag layer is clearly visible and the bright lines across it are cracks in the slag through which the metal underneath can be seen.

Figure 21 — Platform mounting requires more headroom than floor mounting.



The edges of the banks can also be readily distinguished.

The electrode holders with which the furnaces at the new plant are equipped are of the water-cooled shoe and wedge type. However, recently attention has been focused more and more upon electrode holders of the power operated type. Such a device not only helps to provide better working conditions, but also results in a considerable saving of valuable furnace time. On the average, perhaps 10 to 15 minutes per heat, are lost in order to slip electrodes with regular wedge type holders. This amounts to approximately 30 to 50 cents per ton of steel, depending upon the size of the furnace and the length of the heat. Converted into dollars, this amounts to approximately $28,000.00 per furnace per year as the cost of slipping electrodes on furnaces of this size. With a power operated holder, a good proportion of this time and expense can be saved.

In connection with the discussion of circuit breakers in arc furnace service, it is of interest to note that one of the electrical manufacturers has recently recognized the fact that a furnace breaker is primarily a switch, and has designed a special furnace switch which is shown in Figure 23. This switch is designed strictly to open the load currents and not for opening under overloads. It is designed to be very rugged mechanically to withstand the frequent operations encountered in furnace service. The air blast principle is used for interrupting the arc.

To protect against overloads, a back-up breaker would be provided which could serve a battery of a number of furnaces. In other words, for a battery of furnaces there would be provided a single back-up breaker of high interrupting capacity and each furnace would be equipped with a furnace switch of this type.

Since the back-up breaker would take care only of overloads it would be called upon to operate only infrequently and could be of the standard power service design. It should require a minimum of maintenance.

DISCUSSION

PRESENTED BY

H. E. PHELPS, Electric Furnace Superintendent, Rotary Electric Steel Company, Detroit, Michigan

FRANK W. BROOKE, Swindell-Dressler Corporation, Pittsburgh, Pennsylvania

P. E. HAGLUND, Metallurgical Engineer, Ford Motor Company, Dearborn, Michigan

F. C. RIECKS, Foundry Division, Ford Motor Company, Dearborn, Michigan

H. E. Phelps: I was interested in the water-cooled shell. Do you have any ideas as to the savings in the side wall refractories resulting from that?

Frank W. Brooke: The reason for a cast steel shell was because of the war restriction on 1¼ in. thick steel plates. The making of a steel casting so large and intricate could only have been undertaken by a firm such as our customer, the Mesta Machine Company, who know all about the making of large castings and how to handle them.

Figure 22 — The roof has been swung open to show the molten bath.

In cross-section the wall thicknesses were 1½ in. and the spaces between the wall thicknesses which form the water-cooled jacket were 4½ in. wide and go all the way from just above the sill line to the top of the shell. There were four separate compartments, all connected so that the water-cooling could be done in series and in conjunction with a recirculating system for the whole installation. The cost and supply of water was an important item.

Each casting weighed over 51 tons and could only have been made in a foundry adjacent to the melting shop because it could not have been shipped in the regular way. The outside diameter was 19 feet, and the height of the side, which had a round bottom, was 11 feet. It had to be cast upside down and required a very large load of ingot molds to hold down the hydrostatic pressure of the molten steel. In making the first casting this holding down load was not quite sufficient and caused an increase in thickness of the bottom, but did not cause any displacement of the various cores. The working door, the slagging door and the pouring spout openings were all integral with the casting. In making the second shell, the holding down weight was increased and a very excellent casting with uniform thickness throughout was produced.

Three portions of the shell had to be machined, but it could not be put into a machine shop. The foundry set up a special milling attachment to carry out this part of the work. Each casting was also normalized to eliminate stresses.

The economy of the side wall cooling is difficult to evaluate, but it is generally felt that it is well worthwhile. In large electric furnaces it is difficult to establish a yardstick for the life of a side wall. One melting shop will talk in terms of 55 heats, another 250 heats and some will cheerfully talk about 400 heats. It depends, of course, upon the steel which is being made, the crew who operate the furnace, the material used in the side wall, the patching that can be done and whether the figure used is some sort of a record that was once established or an honest, general average.

Kilowatt hour consumption on these furnaces indi-

cated that the water-cooling did not set up any extra heat loss.

P. E. Haglund: What effect does the water cooling on the side walls have on the refractories?

Frank W. Brooke: The water cooling on the side walls had no detrimental effect on the refractories; in fact, it was rather the reverse. It is the amount of cooling on the furnace side walls that establishes an economical wall thickness and defines in some way what the initial wall thickness should be. In the case of these two furnaces the side walls were metal case brick.

F. C. Riecks: Why did you go to water cooling instead of forced air cooling?

Frank W. Brooke: We went to water cooling for two reasons. One was, the customer wanted to try it out, which is a very important reason; and, secondly, we rather agreed with him.

F. C. Riecks: If you made the shell out of plate, you would have to stress relieve it.

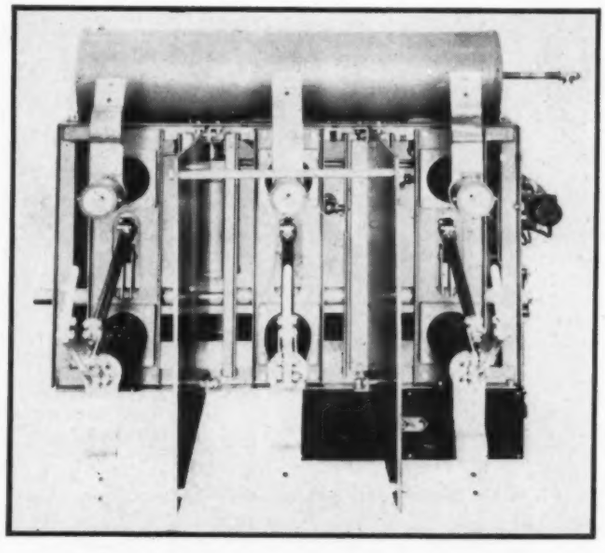
Frank W. Brooke: The whole casting was stress relieved before it was ever machined.

F. C. Riecks: Did you say you would make the next one out of plates?

Frank W. Brooke: Yes, but we would stress relieve all the welds.

F. C. Riecks: If it went out of shape, as most of them do, you would have trouble without being able to fix it.

Figure 23 — A special breaker has been developed to act as an electric furnace switch.



Frank W. Brooke: I do not think a furnace like this will ever get out of shape because of water cooling. We have done it with a furnace of a similar size at Midvale, which was a steel plate job, water cooled to quite a depth down through the top. The furnace stayed in shape and did not have any distortion. We are speaking, now, of course, of large furnaces, furnaces of 50 to 75 tons capacity, and not of foundry furnaces.

H. E. Phelps: Don't you think they might have left out some of the brick, instead of going to 13½ in. wall? I thick a 9 in. would have given greater economy.

Frank W. Brooke: There is a nice balance in thickness of brickwork. Suppose you went further and made it 20 in., you would find you would not get the life out of the first four inches that you do out of the next four inches.

There were some other interesting problems in this plant. During the excavation for the ladle pit it was found that an underground river was flowing underneath the two furnaces. No steel man likes to think of a mixture of molten steel with water that he cannot see. The customer made a very excellent job of handling this very difficult problem, which was one more tribute to the orderliness and cleanliness of the whole plant.

The cover for the slag bucket was designed so that it could be lifted with a magnet. We originally objected to this idea on the grounds that the slagging end of the furnace could not be kept sufficiently clean to maintain a good contact between the metal and the magnet. This, however, did not turn out to be the case. There is a sufficient mass of steel between the refractories to always maintain a good magnet contact, but it is especially successful because of the cleanliness of the whole shop.

F. C. Riecks: How do they take care of smoke removal?

Frank W. Brooke: They don't. The answer to that in their case is that good scrap is used and they have a high, well ventilated building. There is more emphasis on smoke removal in a foundry than in an ingot shop in general. In a foundry, you get much more smoke per ton of steel produced than you ever do in an ingot shop. That has been my experience. In a foundry, you are much more silicosis-minded than in an ingot shop.

F. C. Riecks: Why don't they use a rocker type furnace where you have a pit?

Frank W. Brooke: It is a rocker type.

F. C. Riecks: I thought you said it was a hydraulic tilt.

Frank W. Brooke: Yes, with rocker combined. It is not a nose tilt, like many that you have. You could not afford to make the furnace with a nose tilt. But it does bring up a very interesting question. Any good

steel maker who makes an alloy steel wants to see that the spout is as short as possible. It becomes quite a problem to do that if you use the conventional rocker tilt, because you find as you tilt the furnace, the electrodes and masts foul the crane cables. In at least two installations we have made a compromise between what you get from a nose tilt and what you get from a rocker tilt by a special rocker design.

As furnace builders, perhaps the question which we are being asked at this time more than any other is, "What is the future of the big electric furnace and how can it compete with the open hearth?" As we are builders of big open hearth furnaces, we have been in a good position to study this question. Right now it depends, of course, upon the type of steels which are to be made. As the number of alloys and the percentage of alloys increase, the position of the electric furnace becomes stronger and stronger; in fact, it is safe to say that it has no competition. When you come down to regular common or garden type of steel, the open hearth or the bessemer still reigns supreme, and as we see it, it will be a long time before the electric furnace will be able to make any in-roads into this field.

There has been the same amount of talk about trials and actual installations of duplexing and tri-plexing during this last war as there was during World War I. It requires an exceptional set of circumstances to justify the overall economy of these processes, especially during normal peacetime. The greatest difficulty to overcome in duplexing and tri-plexing is the number of times it is necessary to handle the molten steel.

There are a good many misconceptions as to the capital cost of an electric furnace compared with an open hearth. During World War I an electric furnace was either as expensive, or sometimes more expensive, as an open hearth installation for the same tons produced per month, but that is no longer the case when the full installation is considered.

During war-time the electric furnace suffers somewhat in comparison because of the pegged price on scrap. When we get back to normal conditions, it is our opinion that the same situation will prevail as it did after World War I; that is, first class scrap will be once more obtainable at a price so very much lower than pig-iron, that any cold metal melting in the open hearth would be difficult to justify.

It is interesting to note that it is not so long ago that the electric furnace user would discard any scrap which did not average 95 pounds per cubic foot, most of you know only too well what you have to put up with now. You are often only too glad to get scrap at 70 pounds per cubic foot, and have to put up many times with scrap down to 50 and 60 pounds per cubic foot.

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Reclamation of Oils

. . . . reclamation of oils in steel plants has been doubly economical . . . . it first conserves oil; and second, by removing contamination, it reduces the number of bearing failures with consequent costly mill shutdowns . . . .

by J. D. Lykins

LUBRICATION ENGINEER

YORKVILLE WORKS

WHEELING STEEL CORPORATION

YORKVILLE, OHIO

▲ ONE of the greatest problems of the lubrication engineer and operator is how to avoid the consequences of oil contamination in respect to continued and efficient operation of the machinery under his charge.

The machine designer may have given the proper bearing and gear designs, as well as means for supplying lubricants between the bearing surfaces, but he has little if any control over the maintenance of the lubricating oils which, if not properly maintained, will not render the expected protective service.

All lubricating oils undergo certain physical and chemical changes in service. This occurs regardless of the type of crude from which they are refined, the degree of refining or the provisions made in the oiling system to exclude foreign contamination. Some oils will undergo these changes faster and more extensively, depending on the method of refining and conditions to which they are subjected to in service. Irrespective of the original purity of the oil, the degree of refining and the effectiveness of the system in keeping out impurities, oils become contaminated and unfit for service unless they are cleaned. The oil itself does not wear out as most people are inclined to believe, but becomes contaminated by foreign substances and chemical changes which take place due to heat and agitation. No piece of machinery could operate for any length of time without proper and continuous lubrication. Therefore, we expect a lubricating oil to have the following properties:

1. Proper viscosity which is perhaps the most important property of the lubricant.
2. High film strength.
3. High oiliness or lubricity.
4. High resistance to moisture absorption.
5. Minimum gum formation tendency, which will be free from metal, abrasive and solid materials.

Presented before Chicago Session of AISE Annual Meeting, October 1, 1945.

However, when we subject an oil with these properties to a working condition where they come in contact with:

1. Free and dissolved water.
2. Metal particles.
3. Bearing shock loads.
4. Dust and other solids.
5. Free and dissolved air.
6. Heat.
7. Fuel oil contamination.

the oils will form:

1. Dissolved gases.
2. Free water.
3. Stable and unstable emulsions.
4. Abrasive particles.
5. Unsaturated hydrocarbons.
6. Colloids in suspension or precipitates.
7. Soluble and insoluble resins and gums.
8. Acids, soaps and asphaltic sludge.
9. Free and amorphous carbon.

If these impurities are not removed from the oil they cause:

1. A lower film strength.
2. Changed viscosity.
3. Increased internal oil friction.
4. Lowered oiliness qualities.
5. Excessive bearing wear.
6. Rusted polished surfaces.
7. Decreased absorptive properties.
8. Lower flash and fire points.

Therefore, in view of these reactions, it is imperative that we take all precautions to prevent and remove the contamination from the oil.

There are three methods for purifying the oils, batch, continuous or a combination of both. When we speak of continuous purification, we mean the continuous purifying of all or part of the oil during each cycle.

TABLE I

	New oil	Tandem bearing	Finished mill bearing
Gravity, °API	25.7	26.1	26.2
Viscosity, 100 F—Saybolt	2400-2500	2442	2457
Viscosity, 210 F—Saybolt	155	153	154
Color	7 - 8	Light 8	Green
Neutralization number	0.05	0.1	0.1
Sediment, per cent	None	Trace	Trace
Moisture, per cent	None	Trace	Trace
Ash, per cent	....	Trace	Trace

TABLE II

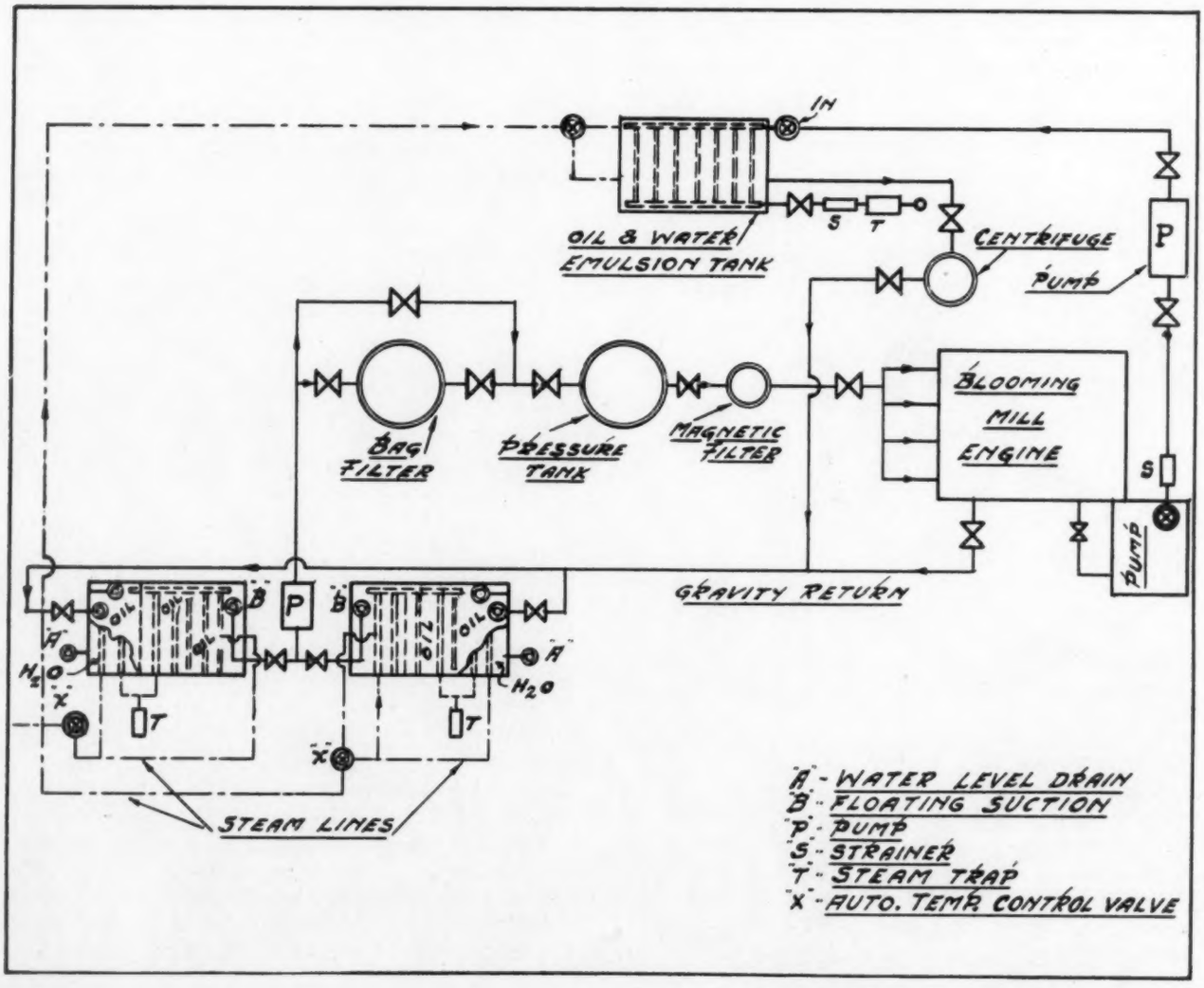
	70 hours Waste type filter	1400 hours Earth filter	New oil
Gravity, °API	31.0	31.3	31.6
Flash	440	430	440
Fire	500	490	505
Viscosity, 100 F	330	295	300
Viscosity, 210 F	57	51	53
Color	Black	2½	2½
Neutralization number	2.25	0.31	Neutral

Either method, continuous or batch, may employ one of the following methods of purification:

1. Screen type strainers or filters.
2. Pressure or vacuum filters.
3. Magnetic filters.
4. Gravity purifiers.
5. Distillation.
6. Centrifuge.
7. Contact earth or adsorbent materials.

Screen type filters or strainers remove the coarse or solid impurities which have gotten into the oil but do not remove soluble impurities, liquid contamination, atmospheric dust, the finer insoluble sludge particles and acids.

Figure 1 — The oil circulation system on this blooming mill uses several of the oil cleaning processes.



The pressure and vacuum filters are identical in design, the difference being the relative position of the oil circulating pump. If the filter is placed in the pump suction line, it is termed a vacuum filter. Otherwise, if the filter is placed on the discharge side of the pump, it is a pressure filter. The pressure or vacuum filter uses metal or fabric screens, cotton wastes, wood wool, activated earth, etc., as a filter medium. The fabric screens, cotton waste and wood wool remove solid contamination from the oil but do not remove liquid contamination and little if any soluble sludge or acids. The most complete purification of oils by filtration occurs when activated earth or adsorbent clays are used as a filter medium. These filters are highly effective in removing the very finest impurities. However, they cannot be used on oils that contain compounding as they remove the compoundings from the oils.

The magnetic filters remove only magnetic impurities from the oil. However, they do remove the fine metallic particles which are not removed by screen type filters. These fine metallic particles do much damage, especially to polished surfaces, as most of the larger metallic particles will settle out in the oil reservoir.

At one of Wheeling Steel Corporation's plants, the back-up roll bearing oil circulating systems on the tandem and finishing mills are equipped with the metallic type screen and magnetic filters. This oil has been in these mills since 1939 and has never been changed.

Table I shows a comparison of tests made of the new oil and the oil in the systems.

These tests show conclusively that this method of purifying is effective and the oils are in excellent condition.

There are also centrifuges on these systems but they have only been used once in the past four years. This was on the tandem mill in 1943 when 1.5 per cent moisture was present in the oil.

At one of Wheeling Steel Corporation's plants adsorbent earth type filters are used on internal combustion engines. The oils used in these motors are straight mineral oils with an oxidation inhibitor and oiliness agent added. Before these filters were added, oil was changed after every 70 hours of operation, for the tractors were operating where acid fumes were exceptionally bad and the neutralization number would go up very fast. The main bearings would last approximately 6-8 months but since these filters have been installed, we have not lost any bearings.

Table II shows a comparison of tests on new oil, on the oil before the earth type filters were installed, and after the earth type filter had been installed.

These tests show that the oil after 1400 hours of operation is still in excellent condition indicating the effectiveness of the filter.

The gravity type purifier removes contamination from the oil by screening or filtration and precipitation. The screening or filtration is basically the same as the pressure filter which was mentioned before, but uses loose materials for a filter medium to give a higher rate of oil flow through the filter. Precipitation or settling method uses gravity to separate the contamination from the oil. Impurities which are heavier than oil, such as water, readily settle out of clean oil. However, some impurities have practically the same specific gravity as that of the oil and cannot be removed by settling. The more nearly equal the specific gravity and the more viscous the oil, the greater the time required for separation. However, heating the oil reduces the viscosity, which reduces the time required for separation, but some sludge impurities are soluble at higher temperatures and will not settle out. Therefore, if sufficient time can be given, more thorough clarification may be had at lower temperatures.

Centrifuge purification is fundamentally the same as precipitation or settling, but faster, for instead of employing gravity to separate the impurities from the oil, centrifugal force is used. The centrifuge only separates liquids and solids, or immiscible liquids and solids having respectively a difference in state and density.

The oil circulating system on a blooming mill engine at one of the Wheeling Steel Corporation's plants shown in Figure 1, employs all the methods mentioned except activated earth.

There are really two different systems, one a closed system and the other salvages the oil that leaks from the engine. The oil in the closed system is pumped to the engine where moisture and other contamination gets into the oil. It is then returned to the storage tank where the oil is maintained at a temperature of 130-140 F. Here the water is removed by gravity settling. The oil is then pumped from the storage tank through a bag type filter where the solid contamination is removed, then through a magnetic filter which removes the finer magnetic metal particles which are not removed by the bag type filter, then back to the engine.

The open system pumps the oil from a sump on each end of the engine, where oil that leaks from the engine is caught, to a salvage tank where the oil is maintained at a temperature of 180 F. The oil is then centrifuged to remove all the moisture, metallic sludge, etc., from the oil. It is then drained back into the closed system.

Distillation is the process of separating a volatile fluid or fluids from a heavier fluid by evaporation. Impurities which are removed from oils by distillation are water, fuel oil contamination and lower molecular weight acids, etc.

Activated earth or adsorbent treatment of oils is accomplished by two methods; namely, percolation, which has been in use for many years and the fuller's earth treatment. The second method, known as contact filtration, has come into practice within the last few years. In the former, the oil to be treated is either pumped up or down, usually down, through a bed of granular adsorbent material which is contained in a vertical steel cylinder. It will be observed that each increment of oil coming through the adsorbent column is exposed to the action of successive portions of the adsorbent thru the presence of an excess of adsorbent material, which results in a highly effective use of adsorbent material.

Contact filtration, the second method, is nothing more than batch mixing and filtering. The oil being treated is mixed with adsorbent earth, usually 200 mesh and up, with the oil being heated to a fairly high temperature. Agitation is maintained during the time of heating or for about one half hour. After this, the oil is filtered through a suitable filter where the adsorbent

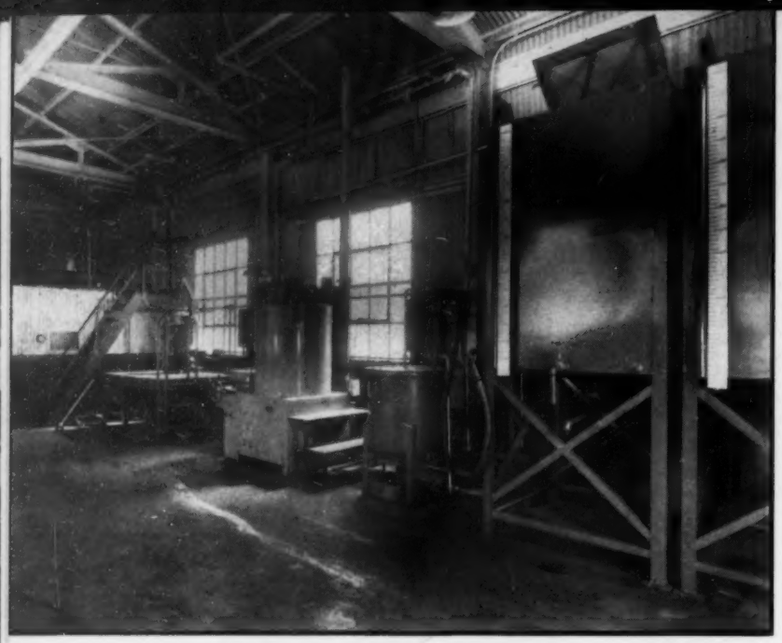


Figure 2 — This oil reclamation unit is of the batch type.

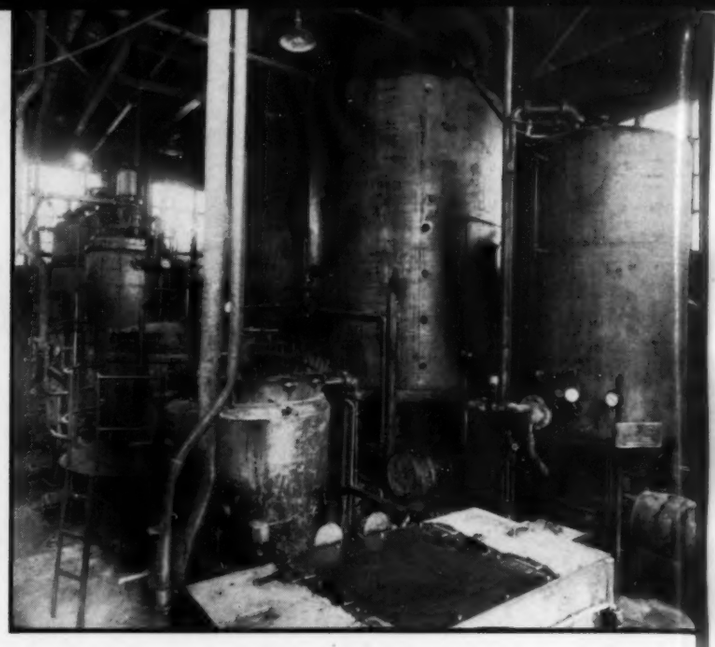


Figure 3 — Palm oil reclaiming unit.

impurities are removed from the oil. This method of treatment removes soluble impurities such as gums, waxes, resins, polymerized compounds, acids and colloidal substances.

At one of the Wheeling Steel Corporation's plants, a batch oil reclaiming system is in use which is shown. It consists of a pre-heating tank, a centrifuge, activated earth type oil reclaiming unit, a sampling tank and storage tanks.

The centrifuge is used to remove excess water and solid impurities from the oils. Some oils need only be centrifuged, especially extreme pressure lubricants, as the extreme pressure additive would be removed by the earth treatment. The oil is then pumped into the activated earth type oil reclaimer which is a combination of distillation and contact filtration. Here the volatile materials are distilled or evaporated out of the oils, such as water, fuel oil contamination and lower molecular weight acids. The activated earth, which is added to the oil before the heat is applied, adsorbs higher molecular weight acids and the other impurities, the oil is then passed through a two-pass blotter press where the adsorbent and adsorbent impurities are removed from the oil. Table III shows the comparison of the tests run on the new, old and reclaimed oils.

Oxygen is the greatest enemy of oil, as the oils are made up of complex mixtures of hydrocarbons which develop impurities by oxidation. This oxidation is accelerated by heat and by the sub-division of the oil into a fine spray or mist, a condition brought about by service in a circulating system.

Oxidized hydrocarbons may be divided into two classes, those soluble in oil and those insoluble. Soluble hydrocarbons are not deposited at normal working temperatures but may be deposited on cold surfaces of cooling coils, interfering with heat transfer, and in other parts of the oiling system where the oil is quiet and there is sufficient drop in temperature. Insoluble hydrocarbons may be carried in the oil circulating system and deposited on strainers, oil pipes, oil passages

TABLE III

Diesel Oils

	New	Used	Reclaimed
Fuel oil consumed	....	10,800 gal	10,800 gal
Flash	435	410	425
Fire	495	470	485
Viscosity, 100 F Saybolt	773	906	764
Viscosity, 210 F Saybolt	72	81	70
Neutralization number	0.075	1.3	0.187

The color of the reclaimed oil and the new oil was about the same.

Motor Oil S.A.E. 20

	New	Used	Reclaimed
Gravity, °API	31.6	....	....
Flash	440	420	435
Fire	505	485	495
Viscosity, 100 F Saybolt	300	285	295
Viscosity, 210 F Saybolt	53	50	51.7
Color	2	3	2½
Carbon Residue	0.02	....	....
Hours Operated	....	2200	2200
Neutralization number	....	0.11	0.07

Air Filter Oil

	New	Used	Reclaimed
Viscosity, 100 F Saybolt	100	140	103
Viscosity, 210 F Saybolt	....	....	....
Flash	360	360	360
Fire	410	410	410
Neutralization number	....	2.64	0.16
Color	2	Black	2

Hydraulic Oils

	New	Used	Reclaimed
Flash	330	335	335
Fire	380	385	385
Viscosity, 100 F Saybolt	180	210	185
Color	2	Dark	2
Neutralization number	....	1.1	0.09

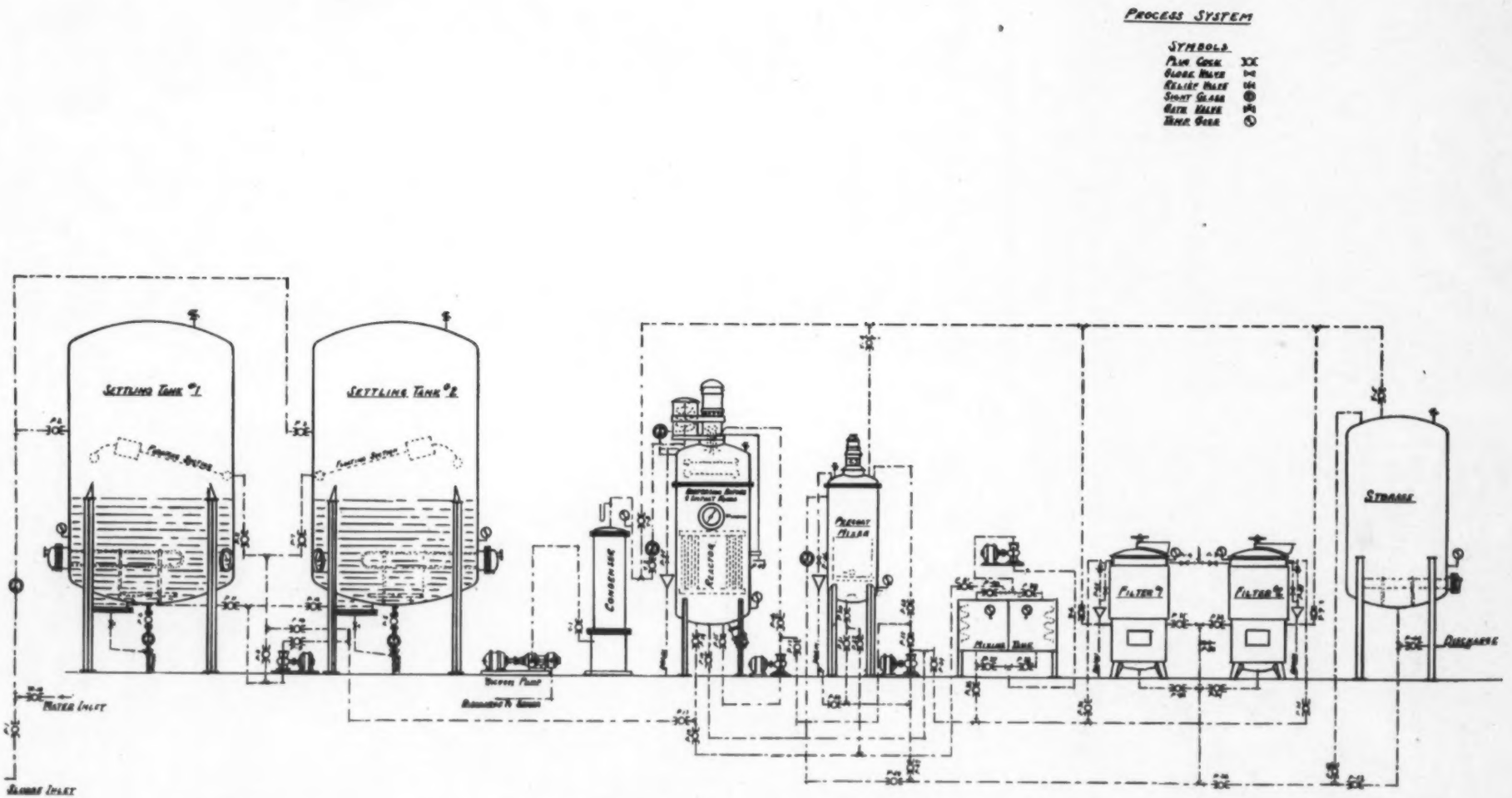


Figure 4 — In this palm oil reclaiming unit, the process allows one batch of oil to be filtered while another batch is being processed.

and particularly in reservoirs. These deposits may interfere with cooling systems, they may clog oil lines, and in severe cases may cause stoppage of oil to the bearings. Moreover, oxidized hydrocarbons, whether soluble or insoluble impair the resistance of oil to emulsification.

Acids are also extremely harmful to oils as they act as catalysts for the formation of emulsions. The volatile acids or lower molecular weight acids are corrosive to the bearings and oiling systems, therefore, the neutralization number of the oils should be checked often.

In view of the harmful results or damage that is caused by impurities in oil, it is much more economical to prevent or remove the contamination than to suffer the consequence.

At one of our plants, a palm oil reclamation unit is in service. This unit, which is shown in Figure 3 and 4, reclaims palm oil that has been used in the process of cold rolling steel on two five-stand, four-high tandem mills.

The used palm oil is caught in a sump under the tandem mills and from there it is pumped into two 10,000 gallon settling tanks. Here the oil is maintained at a temperature of 180 to 190 F to aid in the gravity settling of water and the heavier solid impurities in the oil. These impurities are drained from the bottom of the tank into a sewer. Five-hundred-gallon batches of the remaining oil are then taken from the top of the oil, through a floating suction, to a mixing tank where activated earth and potassium dichromate, the dichromate having been dissolved in water, are added to the oil. The oil is then pumped to the turbine reactor tank where it is heated by means of a steam coil to a temperature of 350 F under 20-25 inches of vacuum. The vacuum is applied by means of a vacuum pump which draws the volatile impurities, in the form of vapor, through a condenser where they are reduced to a liquid state, then through the vacuum pump to the sewer. This procedure reduces the size of the vacuum pump required many times.

The dichromate acts as a catalytic agent in the reaction of settling out the soluble metallic soaps so they can be removed by filtration. The activated earth adsorbs the sludge and high molecular weight acids and acts as a filter medium in filtration, which is the next step.

The oil is then pumped into the prefiltering tank where it is kept at a temperature of 300 F and agitated to prevent the activated earth from settling out of the oil before it is filtered. From here, it is pumped through the filter which uses a blotter type paper as a filter medium. Activated earth and other solid impurities are removed from the oil at this point. This being the final operation, the oil is now ready for storage to be used as needed.

In the reclamation method just described, one batch of oil may be filtered while another batch is being processed.

Table IV shows a comparison of the tests run on the new, used and reclaimed oils.

Examination of these tests on the used and reclaimed oils reveals an increase in iodine and saponification values, and a decrease in neutralization number and ash content of the reclaimed oils. These specifications are the ones we are most interested in as by comparing the specifications of the new and reclaimed oils, we find the differences are not too great and the oil is in good condition and ready for reuse.

Reclaimed palm oil has been used on our tandem mills since 1942 and has proven very satisfactory. We are now using a 50—50 mixture of new and reclaimed palm oil for rolling on the mills.

TABLE IV

	New	Used	Reclaimed
Specific gravity at 15 C	0.9173	....	0.915
Iodine number, Urig & Levin	46 - 60	41	46
Saponification number	190 - 210	140	175
Neutralization number	8 - 20	28.4	20.5
Melting point C	20 - 40	....	22
Ash, per cent	0.09 - 1.75	8.85	0.19

DISCUSSION

PRESENTED BY

C. A. BAILEY, Special Engineer, Operating Methods, Carnegie-Illinois Steel Corporation, Gary, Indiana

J. D. LYKINS, Lubrication Engineer, Wheeling Steel Corporation, Yorkville, Ohio

R. A. KRAUS, Lubrication Engineer, Republic Steel Corporation, Chicago, Illinois

C. A. Bailey: In commenting on Mr. Lykins' paper, it is timely to stress the importance of the subject in connection with the conservation of our natural resources. Whether we have a reserve crude oil supply adequate for one year, or indefinitely, the fact remains that material which has a possible recovery value should not be wasted. Conservation by reclamation is an important endeavor in the field of lubrication and is a broad term extending over the following operations:

1. Maintenance of lubrication systems.
2. Reconditioning of oil while in service.
3. Reclamation of discarded lubricants.

The maintenance of an oil system is the simplest form of reclamation since it may involve only routine duties such as the removal of settled water. Nevertheless, good mechanical maintenance begins with diligent service to the oil system which is the blood-stream of industries' machinery.

Reconditioning of an oil system involves extensive operations such as centrifuging, filtering, and thorough cleaning of the system and tanks. Neglect of reconditioning at the proper time may result in not only costly maintenance, but interrupted operations that are difficult to explain, and far more difficult to evaluate.

The reclamation of oil is a most complicated procedure, approaching the original refining operation, which will restore the physical properties of the lubricant regardless of its contaminated condition. When lubri-

cating oil can be cleaned from its many salvage sources, and re-used in its original service, it is truly a conservation of natural resources.

The analysis of the oil from the circulating systems on Wheeling's tandem and finishing mills indicates not only excellent oil system maintenance, but very good mechanical maintenance of the oil seals and bearings. In this connection, it would be of interest to know the type of bearings and oil seals involved in this mill.

The volume of oil involved in the lubrication of internal combustion engines has justified the development of filters of the small capacity type, adaptable to the effective reconditioning of lubricating oil while in service. It is interesting to note that the oil, after 1,400 hours of operation, was still in excellent condition, thus indicating the effectiveness of the filter. What method of control is used to determine that the oil condition has not changed, or could be used for an extended period of operation?

It would be well for the steel industry to review the work accomplished by the aviation industry during the war, in the reclamation of lubricating oil used on engine test stands. Had it not been for the effective processes and filtering of lubricating oil, many thousands of gallons of oil would have been discarded daily, resulting in not only waste but an added burden to the petroleum industry during the emergency. It appears that the Wheeling Steel Corporation's reclamation method is a modification of this process, and is well adapted to the salvage of steel mill lubricants.

It was my privilege to inspect the palm oil reclamation unit of the Wheeling Steel Corporation located at Yorkville, Ohio, during its initial runs. It is a well-engineered installation, solving a difficult problem.

J. D. Lykins: To answer the first question, as to what type of bearings and seals are used in this mill, we have Mesta oil film back-up roll bearings. The type seals which we use are of bronze construction, operating in a groove and are permitted to revolve with the roll. They are one piece rings with a single cut. There are two seal rings at each end of the bearing, with a drain channel between them, and also a drain channel at the extreme end of these bearings.

The answer to the second question, as to what method of control is used to determine that the oil condition has not changed or could be used for an extended period of operation is determined by the flash, fire and viscosity of the oil in the engines. Samples of oil are taken after every four to five hundred hours of operation.

Member: What kind of earth do you use?

J. D. Lykins: Absorbent type, diatomoceous earth.

Member: Is it the activated class, which has absorbent properties?

J. D. Lykins: Yes. It is not a process given to the clay, but is something inherent in the clay, or a property that enables the class to condense and hold a gas upon it.

R. A. Kraus: Without a doubt, oil reclamation has found its place in modern steel mill practice. At our plant, even the smallest type of filters have found wide usage, and for example, we have installed them in small systems that collect leakage from a number of machines. These types of filters in many cases have materially reduced the lubricating costs of the mills in which they were installed. For a more thorough filtration on batch quantities of oil, we use the diatomaceous silica type of reclamation. This is generally considered as not applicable to additive type oils as the additives may be removed in this process.

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ELECTRIC DRIVES FOR *The Uni-Temper Mill*

. . . . proper coordination of electrical equipment with mechanical equipment is particularly important for the satisfactory operation of mills of this type . . . .

by J. C. McCurley and *J. D. Campbell*

REPUBLIC STEEL CORPORATION
WARREN, OHIO

GENERAL ELECTRIC COMPANY
SCHENECTADY NEW YORK

▲ IN the front rank of carefully finished stee mill products is tin plate stock for the food canning and similar industries. This fact is evidenced by the large amount of handling of the strip steel, the long chain of processes through which the material goes, and the many inspections made during or after each process. Furthermore, the requirements for tin plate of the proper physical properties, good surface and accurate thickness, are becoming more and more exacting.

The "tempering" or "skin rolling" of strip steel is one of the important steps before the finished tin plate is obtained. As is well known, steel is temper-rolled, following an annealing operation, to increase its hardness and strength to specified values, to give it the deep-drawing properties for forming in various shapes, to make the material flat, and to give it the desired surface finish. The methods used for tempering differ widely between plants. Older methods included the two-high train mill, tempering cut sheets which were hand fed. Usually, two-high or four-high rolling mills are now used. Single stand non-reversing mills or two stand tandem mills are used in some places.

The Uni-temper mill is a new type of mill for temper rolling of steel strip. Its use is not confined to tin plate, for it can also be used for tempering heavier steel strip, or for non-ferrous materials. However, during the past several years, the Uni-temper mill has been in successful use, primarily for temper rolling of strip steel at tin plate gauges.

A previous paper "The Uni-temper Mill and Process," by M. D. Stone, published in the January, 1945 issue of the Iron and Steel Engineer gives a description of the mechanical details of the mill, as well as some measure of the good results obtained to date. It is therefore the purpose of this paper to point out the role that the electrical equipment plays in the success of the mill, and to describe in general, the electric motor drives and their means of control. As will be pointed out later, the proper coordination of the electrical equipment with the mechanical equipment on the mill is of utmost importance to completely satisfactory tempering performance. It is believed that in such a mill the need for the careful application of electric equipment is greater than on conventional temper mills.

For completeness, some mention will be made of the operating principles involved in the mill, as these are intimately associated with the type of electric controls used.

Presented before Chicago Section of AISE Annual Meeting, October 1, 1945.

PRELIMINARY TESTS

Previous temper rolling mills utilized working rolls to cold work the tin plate, and strip tension values were only a secondary consideration. The Uni-temper mill is almost the converse of the conventional temper mill, in that the former continuously stretches the material, and any rolling action becomes the secondary consideration. The new type of mill has some of the characteristics of the common stretcher leveller, arranged in such a way that the material can be continuously stretched at a high speed, with the material still in strip form.

The first studies on the relationship of stretch and temper were made in an ordinary stretcher leveller on individual steel sheets, rather than on strip. The sheet was firmly grasped at each end, and stretched a definite amount. These sheets were then examined for hardness, flatness, stretcher strains, and so on. One of the fundamental relationships discovered was that the span between the jaws of the stretcher leveller had to bear

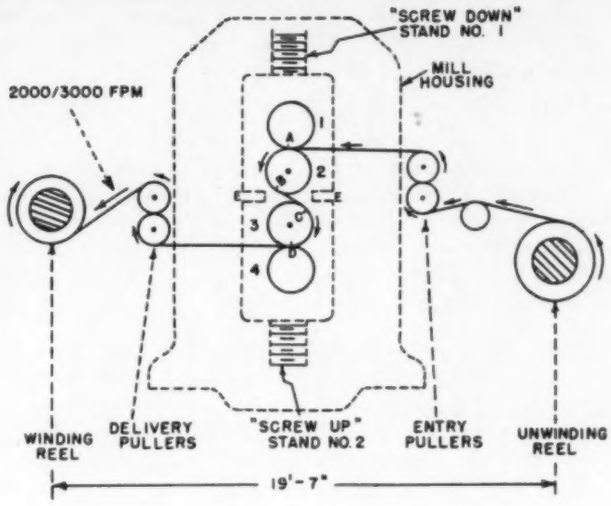
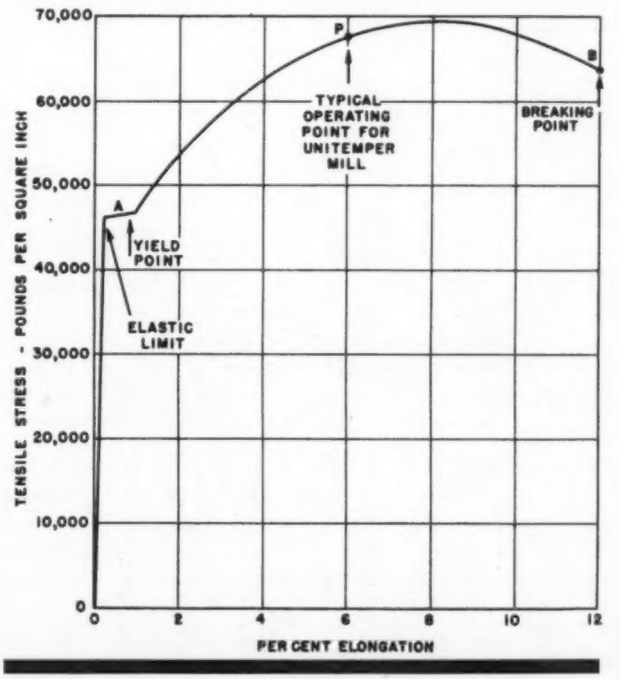


Figure 1 — Elevation of the Uni-temper mill, showing how the mill housing includes two stands, each having two rolls. Most of the elongation is in the free span B-C.

a definite relation to the sheet width. Thus for a sheet about 30 inches wide, the span between the jaws should be less than 15 or 20 inches. If this maximum allowable span were exceeded, the process of stretching the material would result in a "guttering" of the sheet. That is, the sheet would show pronounced longitudinal corrugations in the direction of the stretching. To eliminate this problem, the Uni-temper mill was made so that the unsupported span, over which stretching occurs, is from 10 to 15 inches.

The static stretching tests on the stretcher leveller were then supplemented with continuous stretching tests, using a conventional reversing cold mill. Here the rolls on the mill were opened up so that no rolling on the strip took place. The strip was threaded from the unwinding reel, between the open mill rolls, and then on to the winding reel on the opposite side of the mill. The strip was put under tension, uncoiled from the unwinding reel, and coiled on the winding reel. The amount of stretching and the strip speed were controlled by manual adjustment of the reel motor control. This test indicated that the steel could be continuously stretched with results the same as those obtained on the stretcher leveller. The reversing mill observations again showed the need for reducing the stretch span to avoid strip guttering.

Figure 2 — Example of a stress-strain diagram for strip steel. If the material is being stretched by six per cent the operating point would be at "P."



OPERATING PRINCIPLES

Figure 1 shows in elevation the elements of the mill. The mill itself has the appearance of two mills in one

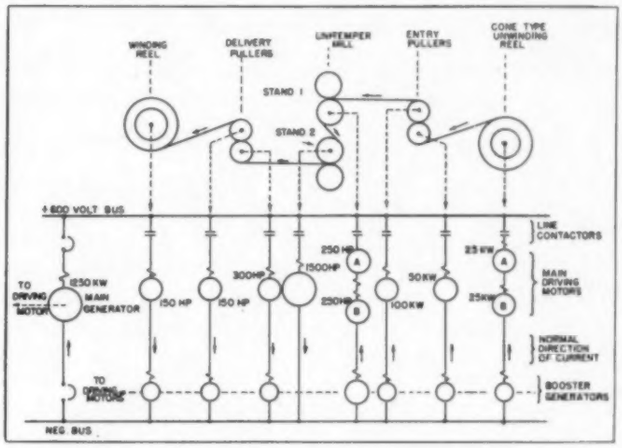


Figure 3 — Main armature circuit connections. Machines preceding stand 2 normally function as drag generators. All other mill drives are generally motoring.

housing and it will be so described. For convenience, we will number the four rolls in the mill housing from top to bottom. Then stand 1 will consist of the two top rolls, one and two. Stand 2 will consist of the two lower rolls, three and four.

With this designation in mind, the mill thus has some features of a conventional 2-high, 2-stand temper mill, but with stand 1 directly over stand 2. Likewise, the mill has conventional cone type uncoiler drag reels, entry puller rolls, delivery puller rolls, and a winding reel. An outstanding difference in the mechanical arrangement of the mill rolls as compared to 2 stands of 2-high mills is in the close spacing of the rolls between stand 1 and stand 2. In practice, roll 2 and roll 3, in the mill housing, are spaced at a fixed distance between their center lines, so that the stretch span B-C is a

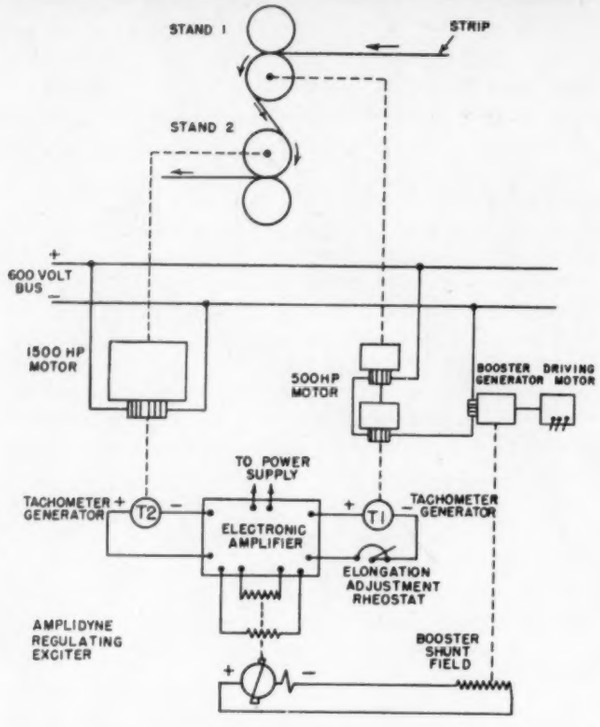


Figure 4 — This elementary diagram shows how the electric-tie operates to hold constant strip elongation.

constant length of 13 inches, approximately. It is over the span B-C that the principal stretching takes place. As indicated previously, any increase in this span much beyond 15 inches or so, would result in unsatisfactory tempering, due to strip guttering.

Still referring to Figure 1, roll 2 of stand 1 is driven by a 500 hp direct current motor. Roll 1 is driven by frictional contact with the strip, and the amount of pressure between the two rolls is determined by the operation of the screw-down motors at the top of the mill housing.

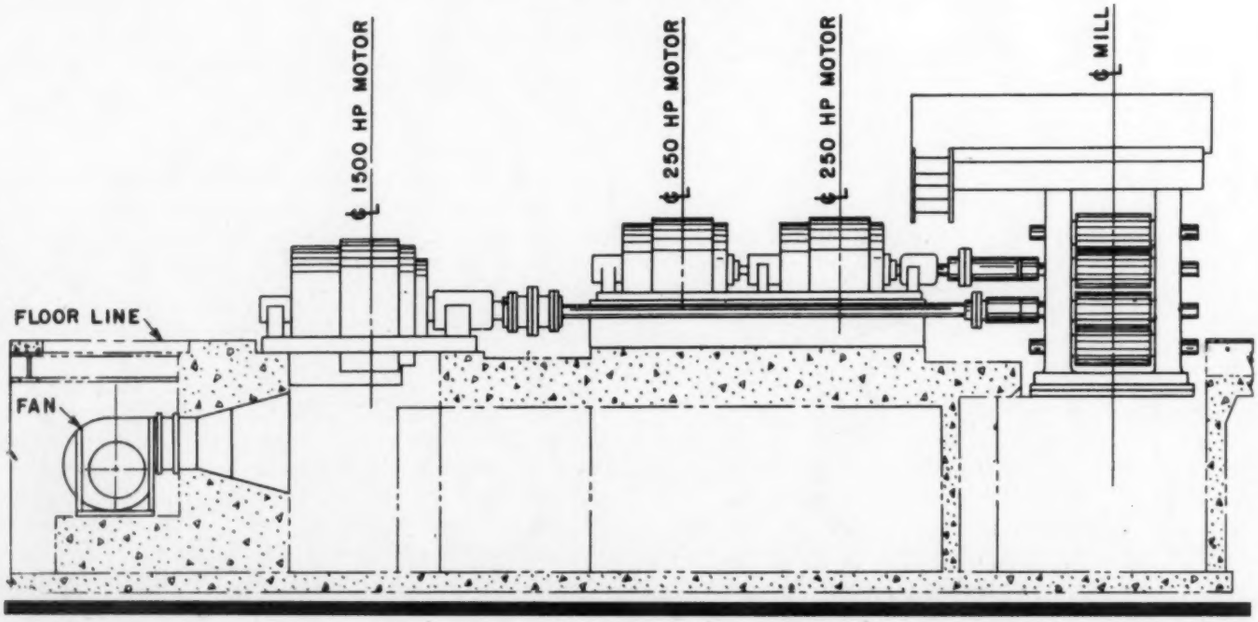
Likewise, in stand 2, roll 3 is driven by a 1500 hp direct current motor, and roll 4 is the idler. Pressure between rolls 3 and 4 is determined by the setting of the screw up motors located at the bottom of the mill housing. Stand 2 rolls function independently of those in stand 1, and the two sets of rolls are in bearing chocks that are separated from each other by mill housing projection E-E.

The strip is threaded between rolls 1 and 2 at A, then around arc A-B, and finally over arc C-D between rolls 3 and 4. Sufficient back tension is held at A by entry pullers and uncoiler and forward tension is held at D by the delivery pullers and rewind reel. Screw-down pressure at A and screw-up pressure at D is maintained so that the strip is elongated at points A and D, by rolling action, by about one-fourth of one per cent at each point.

Now if we maintain the surface speed of the rolls in stand 1 equal to those in stand 2, there will be no elongation, by stretching, over the path A-B-C-D. If, however, we run the rolls of stand 2 at a surface speed of six per cent higher than the surface speed of the rolls in stand 1, the strip will be elongated by six per cent over path A-B-C-D.

For the strip to be permanently stretched over span B-C, the unit tension values must be above the yield point of the material. In Figure 2, we have shown a stress-strain curve for tin plate material. This curve is used for illustrative purposes only, and the values of tension and elongation shown are not necessarily typical. If we stretch the material by six per cent, we will

Figure 5 — Elevation of the mill housing and the main motor drives. Stand 1 is driven by two 250 hp motors, stand 2 by one 1500 hp motor.



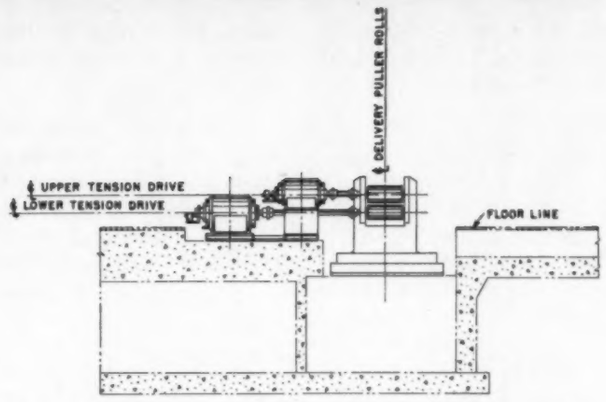


Figure 6 — View of the delivery pullers. The entry pullers are arranged in a similar manner on the opposite side of the mill.

be operating at some point such as "P" on the curve of Figure 2. Most of the elongation is in the free span path B-C, as it is here that the unit tension values are well above the yield point.

FUNCTIONS OF EACH DRIVE

With the fundamental principle of stretching in mind, let us see what each drive must do on the mill. It will be seen that each electric motor, or drag generator, has a definite job to do. With Figure 3 as a reference, each element of the mill must do the following:

a. The unwinding reel has the single purpose of providing back tension in the strip, for the entry puller rolls. If we did not have this back tension, the maximum tension obtainable on the delivery side of the pullers would be reduced considerably. The motors on the unwinding reels act as regenerative drag generators, during normal operation.

b. Each roll of the entry pullers is driven independently of the other. They multiply, in effect, the tension on the entering side of the pullers so as to get a maximum of back tension on stand 1. Such a back tension on stand 1 serves several purposes. It helps to guide the strip straight into stand 1. It aids in obtaining the small reduction by rolling in stand 1. Here again, the entry puller motors are acting as drag generators, during normal operation.

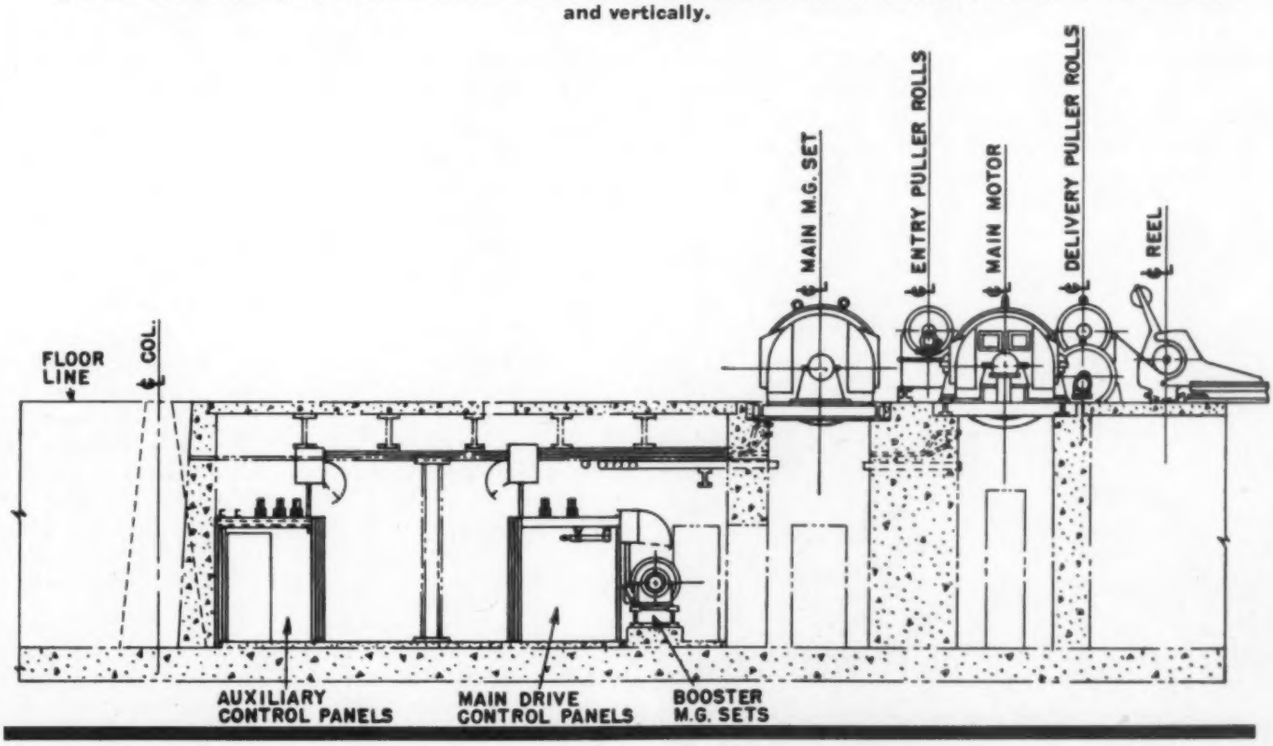
c. Stand 1 gives the strip its first rolling operation, and establishes back tension against stand 2 by the high wrapping friction of the strip around part of roll 2. The motor on stand 1 functions as a drag generator, except during acceleration, when it functions as a motor to accelerate the mill.

d. Stand 2 provides the necessary forward pull for permanently elongating the strip between stands 1 and 2. Stand 2 also gives the strip its second rolling operation.

e. The delivery puller rolls are each driven independdently of the other. The puller rolls help in producing a flat strip, and they guide the strip properly out of stand 2.

f. The winding reel provides forward tension on the entry puller rolls, so that the latter can serve as tension multipliers. As in all coiling operations, tension on winding is also desirable to obtain a tight coil.

Figure 7 — View looking from the drive side of the mill. The motor drives are closely spaced both horizontally and vertically.



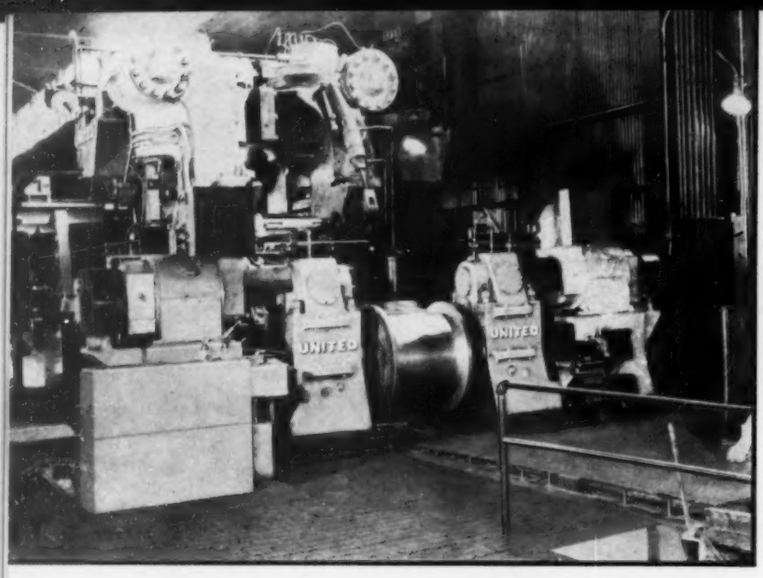


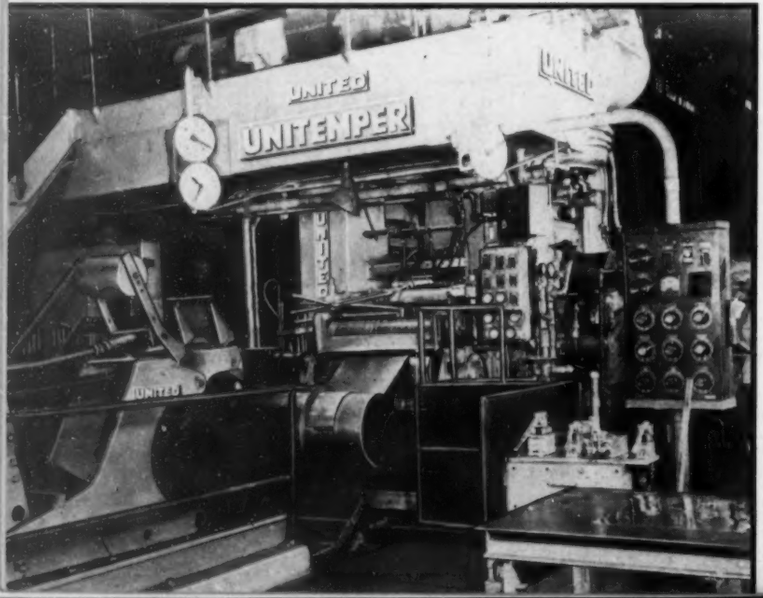
Figure 8 — Looking toward entering side of mill, with cone type uncoiler and two drag reel generators.

ARMATURE CIRCUIT CONNECTIONS

The method of driving the individual reels and rolls is indicated by the schematic drawing of Figure 3. All motors, or drag generators, receive power from the 1250 kw adjustable voltage main generator. Further control of all drives, with the exception of stand 2, is by individual booster generators in each motor armature circuit. The combination of adjustable voltage control plus individual booster generators gives a nicety and flexibility of control not easily obtained by any other means.

Not indicated in Figure 3 are individual protective devices for each motor, dynamic braking circuits, or individual motor jogging connections. These are all similar to that used on modern temper mills of the conventional type. Therefore, it is sufficient to explain here that dynamic braking of the motors is resorted to only when a protective device (such as a field protective relay, overload relay, or overspeed switch) operates. Normal acceleration, deceleration and stopping of the entire mill is by voltage control of the main generator. Individual jogging voltages for the motors are obtained from their respective booster generators.

Figure 9 — Looking toward delivery side of the Unitemper mill, showing wind up reel and operator's control cabinets.



IMPORTANCE OF SPEED REGULATOR OPERATION

The heart of the mill rolling system is in the control of stands 1 and 2. It is the most novel and perhaps the most important part of the electric control.

Previously, we have stated that the main control of elongation is by adjustment of the roll speed of stand 2, with respect to stand 1. Thus in Figure 4 we have shown only that part of the mill where most of the elongation takes place. If stand 1 rolls are operating at 1000 fpm and stand 2 at 1060 fpm, the elongation taking place between the two stands will be very close to six per cent. Suppose, however, that stand 1 should speed up to 1010 fpm, then the elongation will become (1060-1010) ÷ 1010 or about five per cent. In other words, a one per cent speed change in stand 1 has resulted in a decrease in elongation from six to five per cent, or about 17 per cent change in elongation.

A more striking illustration can be made when we are trying to hold, say, 2 per cent elongation. Here if stand 1 is at 1000 fpm, stand 2 will be operating at 1020 fpm. Now if stand 1 increases in speed by only one per cent, the elongation will become one per cent, or a decrease of 50 per cent in elongation. Such a variation in elongation would very likely be completely unsatisfactory.

It is evident then that the control must:

a. Control stand 1 speed with respect to stand 2 speed within a fraction of one per cent. That is, a differential in speed between the two stands must be maintained very closely during threading, accelerating, running and decelerating conditions.

b. Provide a simple means of adjusting the speed differential between the two stands for adjustment of elongation. Elongation up to 12 or 15 per cent in minute steps must be possible.

c. Allow one of the two stands, stand 2, to determine strip delivery speed, and the other stand speed must then be adjusted to give the desired elongation.

An adjustable gear drive for both stands was at first given serious consideration. A single motor would then drive both stands through the adjustable gear. Adjustment of the gear ratio would give the required speed differential between the two stands. Gears did have the advantage of a positive drive using only one motor for both stands. Their differential ratio could not be readily adjusted.

The gear drive, however, was not selected, and an all-electric tie was used in its place. The success of the electric tie was largely dependent on whether or not it could maintain the speed differentials within close enough limits. Experience has shown that the required accuracy is obtained with the electric tie, and the wisdom in using it has been substantiated in several ways. The electric tie is highly accurate, it is readily adjustable for various elongations, and it has provided a means for incorporating other controls.

The electric tie is really an accurate speed regulator. The principal components of the regulator include an electronic amplifier and an amplidyne type regulating exciter as shown in Figure 4. Stand 2 and its motor

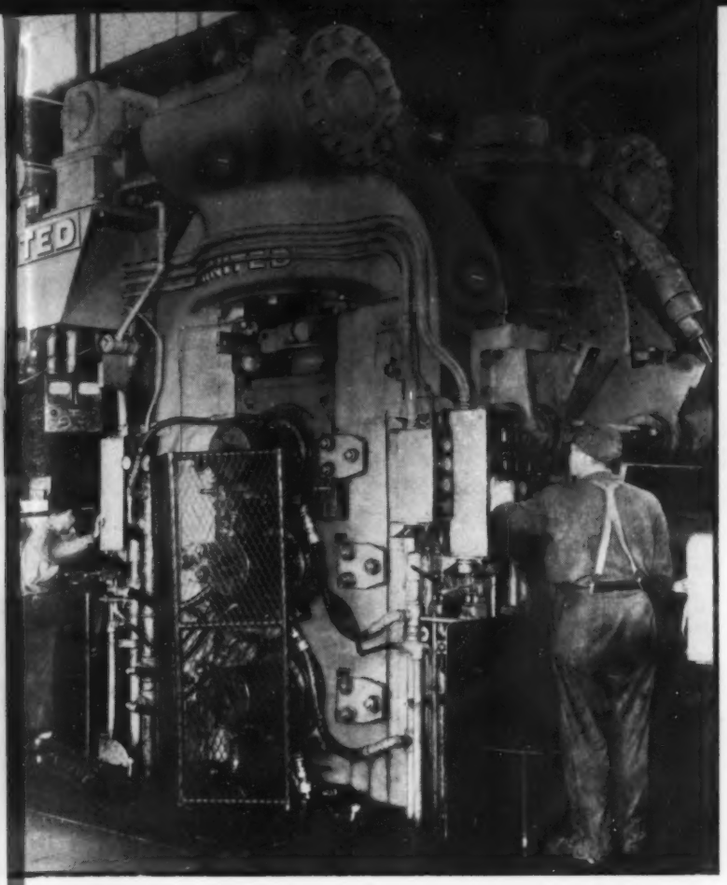


Figure 10 — Close up view of four rolls in one mill housing.

have been selected as the anchor or pivot stand. Stand 1 speed is then adjusted so as to give the required speed differential between the two stands.

In Figure 4, tachometer generator, T2, gives us a speed indication for stand 2. Tachometer generator, T1, gives a similar indication for stand 1. These two speeds, or tachometer generator voltages, are put into the electronic amplifier which holds the percentage differential between the two speeds at some fixed value. A change in this differential in speeds can be made by the elongation adjustment rheostat. The excitation for the amplidyne regulating exciter is controlled by the electronic amplifier. The amplidyne in turn adjusts the excitation on stand 1 booster generator as indicated. Thus stand 1 speed may be raised or lowered by changing its booster generator voltage, thus bringing the two stands at some closely fixed percentage speed differential.

The amplidyne regulating exciter is a unique rotating d-c generator with a rapid speed of response, and requires very little control power. Because of the low amplidyne power requirements, small, "hard" tubes could be used in the electronic amplifier. The combination of "hard" electronic tubes and the amplidyne has produced a reliable and successful regulator, as proved by years of operation on this and other installations. Maintenance cost for these regulator parts has also been low.

CONTROL OF REEL AND PULLER MOTORS

Before describing the operation of the reels and pullers, it is well to repeat that stand 2 is the pivot stand and its speed determines strip delivery speed. Likewise the speed of stand 1 is always a fixed percentage differential less than that of stand 2. Thus, any pulling back on the strip at the entering side of stand 1 must be with that stand establishing the entering speed. In a similar fashion, any pulling on the strip in front of stand 2, is with that stand determining the strip delivery speed.

In Figure 3, the control of the entry and delivery pullers is practically the same. The only basic difference in their control is that due to the entry puller drives being drag generators, while the delivery puller drives are motoring. Since we want constant tension control on the pullers, and since the diameters of the puller rolls are practically fixed, we can say that constant tension control means constant motor torque control. Neglecting all losses, the armature current of the motor is thus a fairly close measure of strip tension. By means of an amplidyne type current regulator, the strip tension at each puller roll is controlled. The value of tension can be easily adjusted by means of a rheostat, but, at any rheostat setting, the strip tension must be held at that value for all mill operating conditions.

The control of the drag reel generators and the winding reel motor are very similar, in that each has an amplidyne current regulator. Here the regulator must hold any adjustable value of tension as the coil on the unwinding reel builds down, or as the coil on the winding reel builds up. Instead of constant torque control, the reel tension regulator effectively holds the reel motor, or drag generator, horsepower constant for any given tension rheostat setting and strip speed. For any other strip speed, the horsepower is automatically increased or decreased, to hold practically constant strip tension.

All puller motor or reel controls have these common features in their amplidyne regulators.

a. Inertia compensation is used to correct the value of quantity being regulated during the mill accelerating and decelerating periods. This correction amount enables the same value of strip tension to be held at all times. In effect, the corrected amount just com-

Figure 11 — Main 1250 kw motor generator set at extreme left. Stand 2, 1500 hp driving motor is shown in the immediate foreground. The double armature 1500 hp motor for stand 1 is at the higher elevation. Unitemper mill itself is on the opposite side of the far wall.

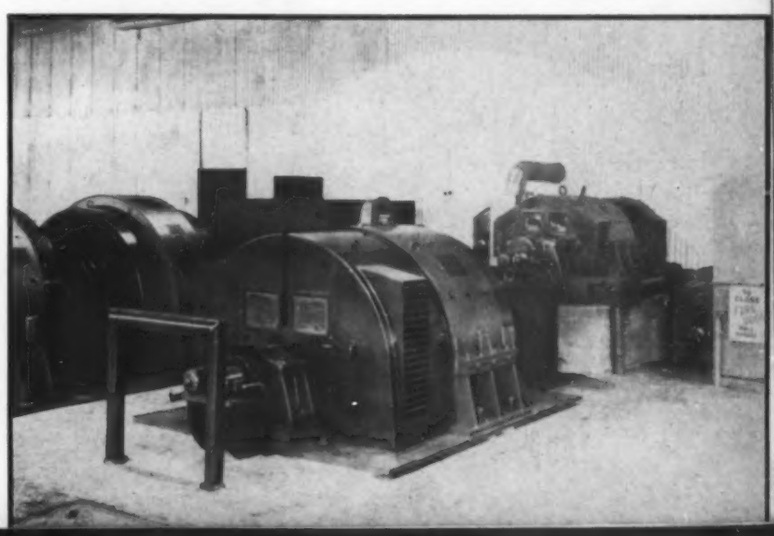


Figure 12 — Main drive adjustable voltage control panels are shown at the right, auxiliary control panels at the left.

pensates for the change in motor torque required during acceleration and deceleration.

b. Individual hand rheostats can be used to adjust the threading speed of each reel or puller motor, before the strip has threaded through, and tension has been established.

c. Automatic means are provided whereby the tension regulators individually change over from the threading speed condition to tension control.

The mill speed as a whole is controlled by raising and lowering the main bus voltage. Further speed control is by means of a separate motor operated rheostat which adjusts the individual motor fields. This rheostat is usually set at some position and changed only at infrequent intervals.

ELECTRICAL INSTALLATION

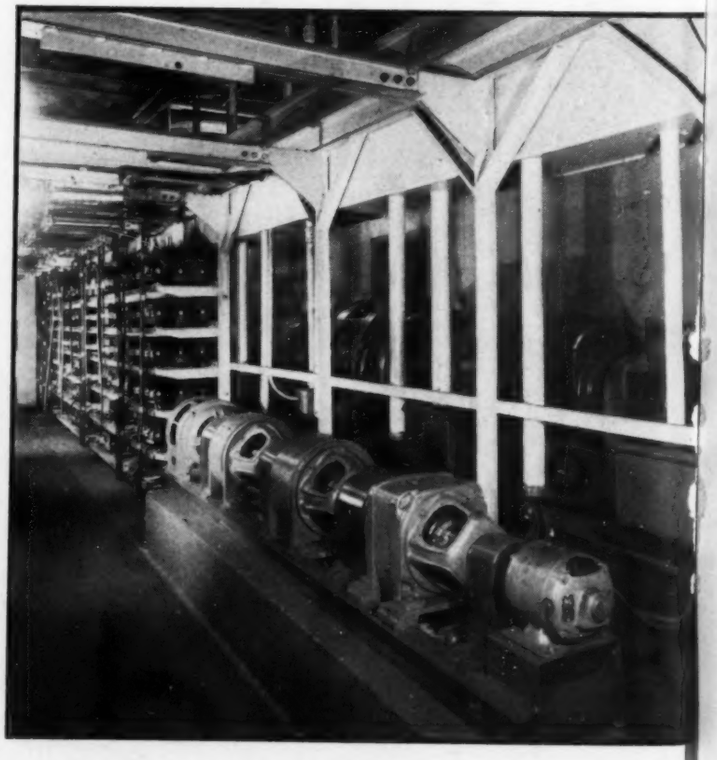
The selection and installation of the motor drives must be coordinated with the mill mechanical equipment in much the same way as motors are carefully applied to large and complicated machine tool applications. In some locations, the available space for the motors is necessarily small. On the other hand, in spite of the limited available room for the vertical and side spacing of motors, the actual floor area taken up by the electric drives is greater than that required for the complete mill housing, puller rolls, reels and other mechanical parts. Certainly this mill is an excellent example where the plans of the mill builder, the electrical manufacturer, and the installation engineer must be coordinated.

A vertical plane parallel to the mill roll axes would cut out a section similar to that illustrated by Figure 5. Another plane through the entry puller or delivery puller rolls would appear like Figure 6. Both these figures show that the vertical spacing between top and bottom motor drives is very small, when we remember that the vertically spaced motor ratings are in the range of 150 to 1500 horsepower, and therefore large in physical size.

Figure 7 shows an elevation view of the mill motor drives, the main motor generator set, the booster sets, and the control panels, when looking at the drive side of the mill. The upper right portion of the sketch further shows that not only are some motors closely vertically spaced, but the horizontal space available for adjacent motors has also been considered. The main motor generator set was located close by the mill motors only for reasons of convenience in designing the common ventilating systems for the electric equipment, and for other similar reasons. For installations where the motor generator set can be conveniently located elsewhere, this can also be done.

In Figure 7, the control room basement contains the ventilating equipment of the non-recirculating type, the booster sets, and the main and auxiliary motor control panels. The compactness, neatness, and effi-

Figure 13 — One of the amplidyne motor generator sets is shown in the front of the photograph. Fourteen amplidyne generators are used for control of the entire mill.



ciency of this installation arrangement are noteworthy. Further details of electrical installation are given in the photographs of Figures 11, 12, 13 and 14.

Figure 8 shows the two 25 kw drag generators mounted above the cone type uncoilers. Like the puller motors, these are low WR^2, class B insulation, force-ventilated motors. Individual generator ventilation is obtained from generator mounted air blowers and filters as shown.

The working area on the operator's side of the mill has a length of 20 feet, approximately. Furthermore, it must be remembered that the mill consists of eight different drives. Therefore, the number of control switches, push buttons, rheostats, and electrical instruments would be large in number. Room for operators' control cabinets for these devices simply did not exist on the single mill housing. Figure 9 illustrates in part how this limitation was handled.

In Figure 9, the usual operators' control cabinets are shown on the mill housing. To the right is a pedestal mounted cabinet. On the wall facing the operators, a special instrument cabinet (not shown) was located so that meters indicating individual motor loads and strip speed were visible to the operators.

The armature circuit in Figure 3 gives some clue as to the extent of any main drive control panels. Figure 12 shows, on the right, the main drive control panels located in the basement below the mill. To the left are auxiliary control panels for the screwdown motors, oil pump motors, small motor generator set driving motors, and the like.

Figure 13 shows one of the amplidyne motor generator sets in the foreground, with the main booster motor generator set in the rear. Fourteen amplidyne generators are used on the entire mill. A clearer view of the booster motor generator sets in the rear of the main panels is given in Figure 14. A trolley beam is located obliquely above the booster sets for handling and maintenance. Connections to the set are through overhead conduit and steel sheet connection troughs.

COMPARISON WITH OTHER MILLS

The Uni-temper mill may be compared as well as contrasted with the conventional 2-stand, 4-high, temper mill. The most conspicuous difference between the appearance of the two mills is in the spacing of the two stands. In the conventional mill, the two stands are usually spaced on horizontal center lines of 10 or 15 feet. On the other hand, the Uni-temper mill has its stand rolls spaced on a vertical center line distance of about 30 inches, between centers of rolls 2 and 3, as indicated in Figure 10. This leads to special problems in the selection of motor drives.

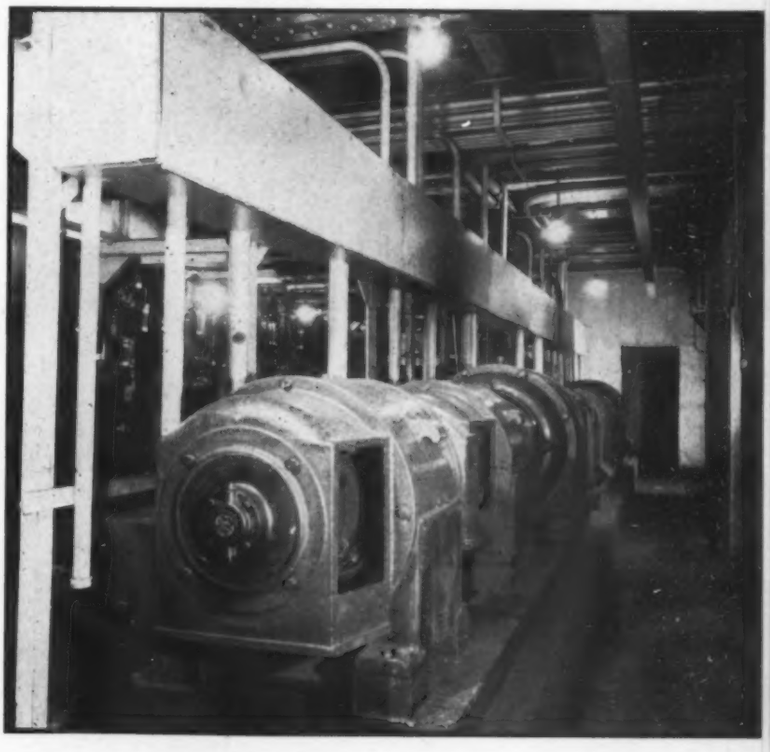
In Figure 11 is shown the motors driving stand 2, and part of the motor driving stand 1. Such an offset vertical arrangement of motors enables us to maintain all motor and spindle shafts parallel to each other, and at a vertical center line distance of 30 inches, approximately. The diameter of the outside motor frame of stand 2 motor is of no great significance; but stand 1 motor frame diameter must be something like 30 inches, minus the diameter of the spindle driving the roll in stand 2. There are definite electrical design limitations in making a motor frame long and "sausage-like" in appearance. We can get a long thin motor by using double armature construction, see the top motor of Figure 11. In this case, the stand 1 motor was rated 500 hp, 250/500 rpm, 600 volts, and consisted of two 250 hp 300 volt, armatures connected in series.

Double armature construction did not reduce sufficiently the frame diameter of the stand 1 motor. Further savings in vertical space were obtained by force ventilating each unit of the stand 1 motor, by adding class B insulation, and by resorting to low WR^2 construction.

As this paper has shown, a special speed regulator, or elongation control, is required on a Uni-temper mill. Conventional two-stand mills have used regulating tensiometers to regulate tension not elongation between stands. Other mills have run both stand motors non-regulating, with tension between stands adjusted by manual control of stand 1 or stand 2 motor speed.

Since the individual puller rolls each has a driving motor or drag generator, the location of the motor horizontal center lines was limited to the puller roll

Figure 14 — Two main booster motor-generator sets are located in the basement behind the main control panels.



diameters. Once again low WR^2, class B insulation, force ventilated motors were used because of space limitations.

Other things being equal, the main generator capacity on the Uni-temper mill should be less than on other temper mills. The 1250 kw generator selected for this mill is greatly oversize, so that any special development could be done on the mill, where more than the estimated generator kw would be required.

If we remember that stand 1 and the preceding drives all act as drag generators, and that stand 2 and the following drives are motoring, we see why the main generator capacity should be less than 1250 kw, see Figure 3. Roughly speaking, the main generator must supply power for the following:

a. Elongation of the strip.

b. All drag generator losses.

c. All motor drive losses.

d. All mechanical losses in the mill bearings, spindles and rolls.

This tabulation neglects the effect of booster generators. The electrical and mechanical losses on and preceding stand 1 drive are in a sense beneficial, as those losses contribute to the strip back tension. Furthermore, the drag generator ratings can be less than if these losses were not present.

Experience has shown that the size of the main generator can usually be less than that required on a conventional two stand temper mill. As will be indicated shortly, it naturally follows that the power consumption on the Uni-temper mill is less than on other mills doing the same amount of tempering.

FUTURE UNI-TEMPER MILLS

The present unit has a rated delivery speed of 2000 to 3000 fpm. Average operating speeds have been about 2800 fpm. Due to the successful operation of the mill at 3000 fpm, definite plans are underway to increase the top speed rating to 4000 rpm. Certain motor changes have to be made to accomplish this speed-up.

The fact that this mill is primarily a stretching machine, and not a rolling mill, has contributed to the ease of operation at higher speeds. Due to the low power involved on the mill, there are no problems of roll heating to be considered. Consequently, Uni-temper mills with operating speeds of 6000 fpm are being contemplated.

SUMMARY

From the electrical man's viewpoint, the equipment has these outstanding features:

1. Dependable and consistent mill motor performance at high speeds with a minimum of maintenance per drive.

2. Adjustable elongation control with a simple, trouble-free, electronic-amplidyne speed regulator, having an accuracy of one-fourth of one per cent, or better.

3. Adjustable tension control on all puller and reel motors using amplidyne generators as regulators.

4. Adjustable voltage control of the main generator, using an amplidyne voltage regulator.

5. Reduced electric power consumption per ton of tempered strip.

Through the combined efforts of mill builder, the steel mill operator, and the electric equipment manufacturer, the Uni-temper mill has been proved a practical machine. It is beyond the experimental stage, and is used regularly on production schedules.

DISCUSSION

PRESENTED BY

M. D. STONE, Manager Development Department, United Engineering and Foundry Company, Pittsburgh, Pennsylvania

J. D. CAMPBELL, General Electric Company, Schenectady, New York

C. E. HOMER, Electrical Superintendent, Youngstown Sheet and Tube Company, East Chicago, Indiana

J. C. McCURLEY, Electrical Engineer, Republic Steel Corporation, Warren, Ohio

G. E. STOLTZ, Manager Steel Mill Engineering Department, Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania

L. F. McCAFFREY, Engineer, Industrial Sales Department, General Machinery Division, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin

E. E. MAXWELL, General Foreman, Carnegie-Illinois Steel Corporation, Gary, Indiana

M. D. Stone: The electrical problem is the main problem in controlling a mill of this type. In the early days, we were considering driving the mills mechanically

and our objection to the mechanical drives were primarily lack of flexibility. After numerous conferences with various engineers, we saw the problem could be solved, and I will say we are entirely satisfied with the solution at all speeds. In fact, I think the higher speeds are better than the lower speeds, and that is what we are concerned with mainly.

The mill has been operating now for a couple of years carrying the entire production of the plant. As was mentioned, the mill is now being rebuilt in many mechanical aspects and modified electrically to have an increased speed of up to 4000 feet per minute, and to handle larger coils. When we first built the mill, we couldn't be certain that it was going to be a success. It was built so it could be modified. To do that, we made certain compromises mechanically which we are now going to eliminate by changing over to what will be the basis of our future mill designs.

If the first design looks predominately electrical to you, as it must, the next one will be even more so because of the higher speed, since the differential power is in proportion to the speed increase. The mill itself will be even smaller, because the mill, as built, is heavier than required. Therefore, the next new mill will look like a series of motors and generators with a little gadget in between.

There are many aspects of this development that please us. One of these is the low power consumed in the operation. Another, is that mill roll temperatures run colder than the bearings, even though they be anti-friction bearings; so we have no hesitation whatsoever in going to higher speeds because of considerations that are usually limitations in high speed temper rolling.

It will be about four or five months before the alterations are made but we have no hesitation about going to the higher speeds with larger coils, which operation seems highly desirable.

Member: Why does the stretch length between the two stands have to be so short? Secondly, could you tell me whether or not the existing drives have been large enough?

M. D. Stone: The stretch length between the two mills is (it is set at 13 inches approximately) such that, for the narrowest strip that would be normally handled on the mill, no corrugation will take place. It can be increased.

In the conventional control of temper, the percentage of reduction you take is so small that the differential in thickness between the strip going in and going out cannot be used as a criteria, so an operator does not know what properties he is getting when he starts. However, he knows pretty well what he will get by the setting of the mill. Now, in the Uni-temper mill, the thing that corresponds to reduction is elongation and that is very easily indicated. So if you want certain properties and they require 6½ per cent elongation, you are continually aware of what elongation you are taking. The operator has that entirely under his control.

J. D. Campbell: As to the power requirements on the Uni-temper mill, we find that each motor, with one exception, is operating at or below its rating, depending on the particular tempering schedule. The exception case is stand 1 motor, which is overloaded on some rolling, or stretching, schedules. We might better have used a slightly larger motor on stand 1, instead of the present one of 500 hp. However, when plans were completed for speeding up the mill to 4000 fpm, the new motor for stand 1 was selected sufficiently large, based on our operating experience at and below 3000 fpm.

The main generator, rated 1250 kw, was purposely selected larger than necessary. Thus we could take care of any contingency, in case the originally planned mill arrangement had to be changed considerably. When the mill is speeded up to 4000 fpm, the power taken from the main generator will be correspondingly increased; but the generator will still be operating below its kilowatt rating.

C. E. Homer: There is one question I would like to ask, that is, the reason for the difference in size of the two generators on the entry tension rolls and the two motors on the delivery tension rolls. Is this difference in size made necessary due to space limitations or is there some other reason for having this size difference?

M. D. Stone: We started out not knowing all the characteristics of the mill and we made some guesses. We were over conservative. We had more power on the motor-generator set than has been required. We didn't put as much power on stand 1 as we should have because the power used on the Uni-temper mill is the difference between that of the two stands. As far as the drag and pull units are concerned, they were more or less determined by conventional practice in conventional mills. At one time, we were very much tempted to have no drag units on the entry side. In other words, the tension requirements are, as stated, primarily determined by the drives on the two mill stands.

The amount of tension was influenced by several considerations. You must actually stretch the strip. If you raise the top idle work roll and the bottom idle roll, and do no rolling, you can stretch the strip entirely by tension; and the pull to do that would be created by the generating capacity of the top stand motor, plus the drag pullers, plus the pay-off reel, resisting the motor on the bottom stand plus the delivery motors, plus the rewinding reel. We have made tests, and tried these combinations. We now have much data on which we can base new designs.

Member: I would like to ask a question on the elongation device. How is it set to compensate for different roll sizes? Also, what is the advantage of so many drives on your pulling machine? There is one on each roll. It seems that there are many motors and pieces of equipment to give trouble from an operational standpoint. I would like to know what the advantage would be.

J. C. McCurley: In answer to your first question in regard to the roll, Figures 3 and 4 are not complete in detail and there are rheostats to compensate for the

various roll sizes. These rheostats are set to specific places that are marked to compensate and provide for proper regulation for the different roll sizes.

J. D. Campbell: The second question has no doubt been raised because there are so many rolls, each individually driven by a motor. Actually, the number of motor drives on a Uni-temper mill is the same as on a conventional two-stand temper mill having individually driven entry puller rolls on stand 1, and individually driven delivery puller rolls on stand 2. One difference between the two types of mills is in the fact that all motors on the Uni-temper mill are physically so much closer together. Aside from this, the electrical maintenance requirements, and the like, should be very little different than on a conventional two-stand mill of the same rated speed and with motors of comparable size.

Member: May I ask another question along that line? In other words, say you have one of the rolls more or less generating back to the top circuit. What advantage are all your boosters, since you don't have a large differential?

J. D. Campbell: It is true that the drag generators at the entering end of the mill operate at a speed only one to about 12 per cent slower than the motors on the delivery end of the mill. This differential in speed could easily be obtained by individual motor field control; although such a scheme would only be satisfactory at the higher operating speeds. When the mill is at rest, or at low threading speeds, the main bus voltage is so low that only the use of booster, or bucking, generators gives good tension control at the reels and pullers, and good speed differential control between stands 1 and 2.

Let us take two examples. First without a booster, or bucking, generator on the entry puller, we could not hold any stalled tension, for under this condition the main bus voltage is zero. Secondly, if we accelerated the mill from rest to threading speed, still without any booster generator in series with the entry puller motor armature, the puller would momentarily motor forward, tending to throw slack in the strip between the entry puller and stand 1.

Member: There is such a small differential between your rolls, while you have a large differential in the reels.

J. D. Campbell: The boosters, or bucking generators, used with the entry puller drag generators and on stand 1 motor have enough voltage range to take care of variations in strip elongation, variations in roll diameters, and variations in load, IR drop, of the drag generator armature circuit. The boosters in series with the delivery puller armatures have a lower range, as the puller speed here is not changed by any adjustment of strip elongation between the two mill stands. The boosters in series with the drag reels and the winding reel motor armatures have the same functions as on any similar type of cold mill. The differential in reel speeds from an empty reel to a full reel (during normal running) is taken care of primarily by automatically adjusting the reel motor field strength, and not by booster voltage adjustment. The booster serves several other purposes.

G. E. Stoltz: Those of us who have worked with cold rolling for a number of years have realized that this problem has moved from the rolling of the steel by roll pressure to using of tension and gradually increasing the tension until as in this case most of the work done is by tension. I understand that the reason for elongation control, rather than tension control, is to attain the same amount of work hardening regardless of whether the strip may be on or off gauge. The question of IR drop has been raised. One reason for using the IR drop is to attain the same result at low speed as high. It is more difficult to obtain the same accuracy at lower speed than high. I had an opportunity to read the paper before presentation and the first question that arose in my mind was the great difference in rating of the main stand motors. It seemed to me those two motors should not be too different in rating because the only work that is being done is the elongation of the steel with some slight reduction in each pair of rolls.

J. C. McCurley: The selection of 1500 horsepower on stand 2 was largely based on a duplication of a drive in use elsewhere in the plant, and it was at that time considered a little bit larger than was needed. We have found out that the drive on the stand 1 was selected a little low and in the future these will be nearer the same rating.

L. F. McCaffrey: I would like to know whether it is possible to attain all tempers, such as T-1, 2, 3, 4, 5 and 6 with the use of rim steel only, without adding phosphorous.

M. D. Stone: We haven't tried all tempers. We have made T-5 however. I would guess we could go higher. T-4, the problem that was before us at the time of designing the mill, has been easily accomplished, although T-4 is not the largest percentage of product. T-3, the major product, is very easy to produce. You have to watch the anneal quite carefully in getting the higher temper.

E. E. Maxwell: You are speaking about elongation and making the T-1, T-2, T-3, T-4 and T-5 Rockwell out of rim steel. You mention the fact you have to regulate your Rockwell hardness coming out of the anneal. How many points of Rockwell do you raise from the annealed value to your finished value?

M. D. Stone: That isn't entirely settled or standardized, but about 12 points. We are doing some more work on that. We've done fifteen and sixteen points in special cases but that is not regular operation.

E. E. Maxwell: Do you find any difference in your flatness in going from one extreme to the other? In other words, if you are taking one coil make it T-1 temper, and if you take the other half of the coil and make it T-5 temper, would you use your screws? In our experience when we have a hard temper to make, we go into a rough roll on the back stand and we feel that is better for making the desired temper.

M. D. Stone: While the stretch in the mill is by far the dominating action, there is some little rolling done in the bottom mill, which will vary, and similarly on the top mill. We have also played around with the idea of roughing the surface. When you roughen the steel surface and then mash it down again, you get a hard surface, with the steel still soft in the middle. It is like a sandwich, and it has slightly greater fluting resistance.

The Rolling of Steel for Saws

. . . . rolling steel for saws is an art which can be developed only from long experience . . . .

by P. J. Britt

ASSISTANT SUPERINTENDENT

SIMONDS SAW AND STEEL COMPANY

LOCKPORT, NEW YORK

▲ THE Simonds industrial dynasty was founded 114 years ago in Fitchburg, Massachusetts, when Abel Simonds began the manufacture of scythes in 1832. The Simonds steel plant was originally built in Chicago, Illinois, in 1900, and was moved to Lockport, New York, in 1911. It is a jobbing mill and consists of electric melting furnaces, steam forging hammers, bar mill, sheet mills, a plate mill, a band mill, a cold rolling department, and a cast magnet department. More than three hundred grades of steel, running nearly the full range of alloy content, are processed through these units.

This paper will describe the rolling of selected grades that go into some of the products, as wide band saws, hack saws, circular saws, and cross-cut saws. As a preliminary to the finishing operations of these specialties, a brief mention should be made of the manner in which the steel is prepared for rolling.

All the ingots, 8, 10, and 14 in., are cogged on two hammers. The wide range of grades, the diversity of application of these steels, both as to section and quantity, do not make mill cogging feasible. The surface cleaning and conditioning of billets, slabs, and blocks are done by means of grinding, pickling and chipping. Here again, the sizes and shapes, as well as the variety of high alloy and special purpose steels, do not lend themselves readily to the latest high production cleaning methods.

The billets and slabs intended for sheet mill orders, including those for most of our saws, are recogged on a three-stand two-high 24 in. sheet mill, used primarily for such intermediate work. The roughing rolls are 54 in. long, with a motor driven screw-down. In No. 2 stand is a set of barrel edging rolls with eleven passes, running from 16 down to 6 in., and adjustable by means of a large vertical wheel operated by hand. The rolls in No. 3 stand are 24 × 46 in., the top one being run by friction. The bulk of the recogging on this mill is confined to No. 1 stand, although No. 3 stand is brought into play on wide or thin work. A limited amount of finishing is also done in the third stand. The recogging off this mill is sheared into blanks or bars for the finishing mills.

WIDE BAND SAWS

Our wide band saws are made from 2½ per cent nickel steel containing 0.75 carbon, and run from 5 to 18 in. in width, from 0.035 to 0.140 in. in thickness, and up to 66 feet in length. They are used extensively in the lumber industry throughout the United States and Canada.

These bands are rolled on a four-stand train, 22 × 30

Presented before AISE Buffalo District Section Meeting, January 10, 1946.

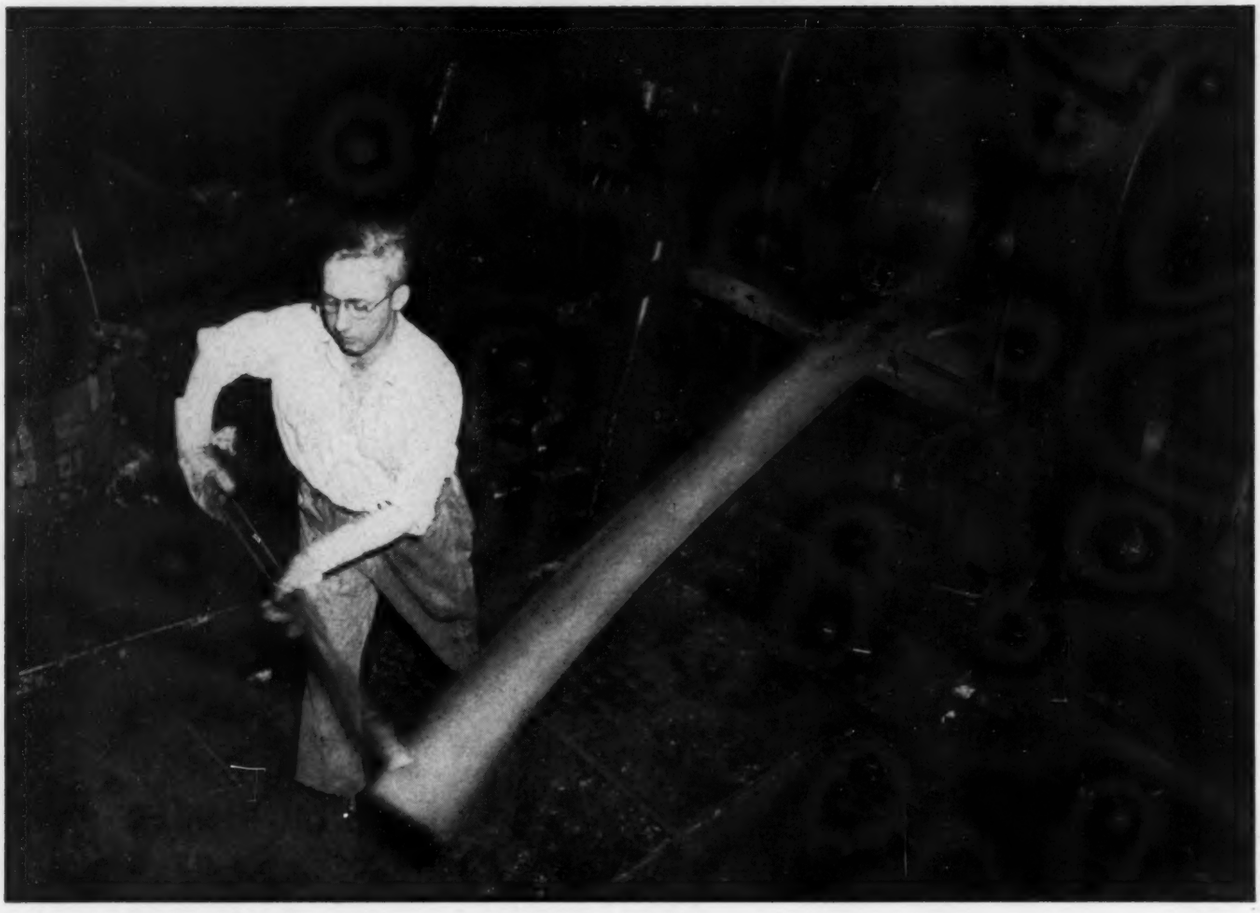


Figure 1 — Back view of cross-cut mill showing the catcher laying down a rolled 6 ft saw plate.

in. mill, with chilled sheet rolls in stands No. 1, 3, and 4. The roughing set is three-high, with the middle roll 15 in. in diameter and run by friction. The screws in this stand have a 1 in. pitch and are manipulated by a vertical wheel. In No. 2 stand is a two-high barrel edging set with 15 passes in it, which is also controlled by a vertical wheel for any adjustments in the width of the material being rolled. The two wheels are between No. 1 and 2 stands, and if they are being used on the same order, the operator merely turns around from No. 1 wheel and he is in position to work No. 2 wheel. No. 3 stand is three-high and, like No. 1 stand, has a 15 in. middle roll, but both the middle and top rolls in this set are friction driven. The two high finishing set has a 22 in. bottom roll and a 20 in. top roll, the latter run by friction. The bottom finishing roll is crossed a ½ in. while all the other rolls in the mill are turned straight.

This unusual mill is also distinguished in its set-up and operation by having cast steel housings, couplings, spindles and breaker blocks. The roller uses entering guide boxes with side guides and top and bottom guide plates in stands No. 1, 3, and 4, and bottom guide plates at the points of delivery. Water is employed on the roughing rolls to keep them cool, and also to aid in removal of the scale, characteristic of nickel steels. The speed of this band mill is 82 rpm and, in common with our other mills, it is electrically driven.

The heating furnace for this unit is 18 ft long, 6 ft wide, opening on both ends, and fired by Bunker C No. 6 oil through six burners on one side of the furnace. The bands are rolled from sheet bars ¾ in. thick up to 18¾ in. wide and 16½ ft long, weighing from 45 lb up to a maximum of 600 lb. They are heated to a temperature of 2050-2100 F for rolling.

Bands 10 in. wide and under, in the thin sizes, require one or more reheatings to finish them. This is done by rolling them up in 4 ft diameters and putting them on edge in the slow fire to bring them back up to 1500 F. They are pulled out, opened up and rolled to size unless another reheating is needed. The bands receive three or four passes in the finishing stand, depending on thickness, and most of this work is carried on with the material at less than 1000 F. The extra passes are necessary not only to get them down to the thickness ordered, but also to reduce the crown in the center to a minimum, to eliminate any wavy condition, and to deliver the product flat and straight.

All bands are rolled full to size in width and to a minus 0.000 plus 0.010 in thickness. They are shipped

Figure 2 — Here the scale is cleaned from a 390 pound octagon block, made of 2½ per cent nickel steel, for a 72 in. diameter saw.

in their natural or as-rolled condition, rolled up in miscellaneous diameters 4 ft and over for convenience of loading and nesting in the box cars.

HACK SAWS

Hack saws are made of three kinds of steel — high speed, molybdenum, and tungsten. The high speed and tungsten steels have long been recognized as standard for hack saw manufacture. The molybdenum type is a comparatively new member of this team, having found favor and wide acceptance before the United States entered the war in 1941.

The high speed steel used for hack saws is the 18-4-1 grade, that is, 18 per cent tungsten, 4 per cent chrome, and 1 per cent vanadium. The well-known tungsten type contains 1¼ per cent of that element and an equal amount of carbon. The molybdenum steel also has 1¼ per cent carbon and ½ per cent of molybdenum. The three kinds of steel are made for either hand or power machine cutting, the hand blades being confined to 0.025 in. thickness, while the power blades are manufactured in 0.032, 0.049, 0.065, 0.072 and 0.100 in. thicknesses.

All our steel for hack saws is finished on a double-stand two-high 26 × 32 in. sheet mill, with a speed of 43 rpm. One stand is used for breakdown and the other for finishing. A smooth, carefully dressed set of finishing rolls is an accepted requirement in the rolling of good hack saw steel. The top and bottom rolls are each crossed ¾ in., for a total of 1½ in. When the rolls are changed for a run of hack saw finishing, it is customary to spend a day, or turn, on some other sheet work in order to get the rolls hot and full in the center.

Hack saw steels are rolled at low heat for desirable physical properties, as well as for freedom from scale and decarburization. The furnaces for this work consist of one "hot fire" for all breakdown done in the roughing stand, and one "slow fire" for reheating and finishing purposes.

The blanks are conditioned by annealing, followed by pickling or sand-blasting. For 0.025 in. finishing, such as the molybdenum type, this conditioning work is performed on the blanks while they are in four-multiple lengths. They are annealed in a gas fired four-zone continuous annealing furnace, sand-blasted, then sheared and matched up. The single blanks, which are ⅛ in. thick, and weigh 10 lb each, are sheared to

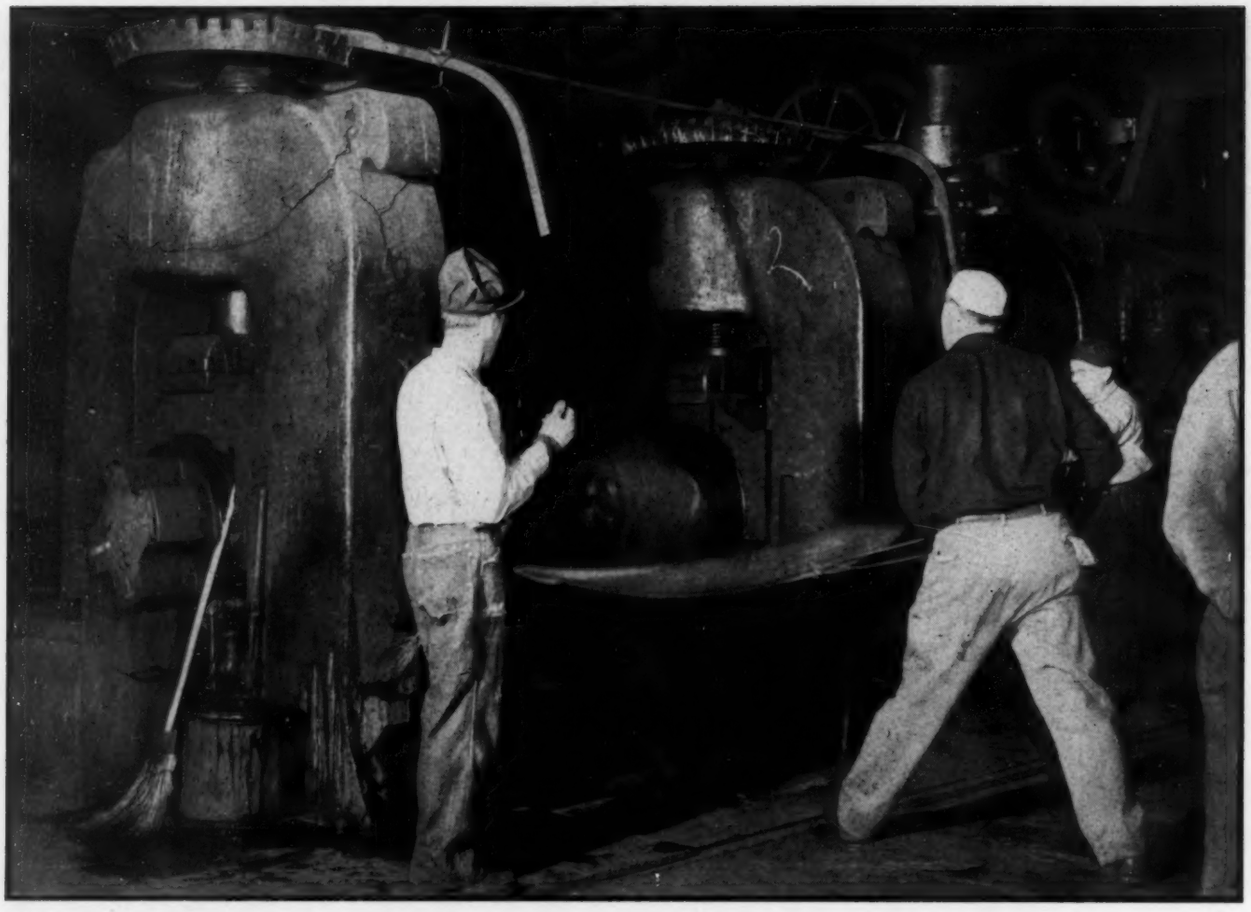


Figure 3 — This 30 x 90 in. finishing stand is rolling an octagon plate for a 72 in. x 0.240 in. thick circular saw.

width for "cross-rolling," which means at a 90 degree to the direction of the previous mill operation.

It is common sheet mill practice to roll thin sizes in "packs," for example, three sheets of 0.032 in. thickness at one time, or four sheets of 0.025 in. thickness, or eight sheets of 0.012-0.015 in. thickness. The roller usually does four packs of 0.025 in. hack saw, regardless of grade, in a "heat" or "round." A typical heat of this thickness is as follows: Sixteen blanks are charged in the hot fire, which is at a temperature of 1550 F and, when sufficiently heated through, they are withdrawn in pairs. The first pair is given four or five passes in the breakdown stand and then laid on the floor near the slow fire. A second pair is taken from the furnace and put through the mill, but it receives one less pass so that it will be shorter than the preceding pair. The second pair is placed inside the first pair to form a pack, and immediately put into the slow fire. This is repeated three times until the sixteen blanks have been made into four packs. The first reheating is at a lower temperature than was given in the hot fire, and the four packs get five passes in the finishing stand. The inside sheets in a pack hold their heat better than the outside ones, so the rolling action has elongated them to exceed the length of the outside sheets. Each pack is put on the floor, pulled apart and sheets shifted, and then returned to the slow fire for the third and lowest temperature of the round. The roller gives the packs four passes in the final operation, which is completed with the sheets under 1000 F. In some cases, the finished sheets are put into a pile as they leave the mill, in others, the packs are returned to the slow fire, brought up to 1100 F, and put through a roller leveler.

The hack saw roller has an important assignment because his best efforts and those of his skilled men are needed to meet the exacting requirements of the saw manufacturer. His rolls, his furnaces, his blanks, his men, in fact, every condition or agency associated with the job must be right, or results will not be up to the rigid standards in effect today.

Hack saw steel, regardless of grade, is ordered in standard multiple lengths according to thickness. For instance, the 0.025 in. thickness is rolled to yield sheets 50½ in. long, which have four multiples of 12⅝ in., or sheets 53⅛ in. long, which have five multiples of 10⅝ in. The width of the sheets is also standard, being 18⅛ in. for 0.025 in. high speed and 20⅛ in. for 0.025 in. in the other two grades. The shearing is done to the above specifications as the next step after the material leaves the mill. The inspection that follows is

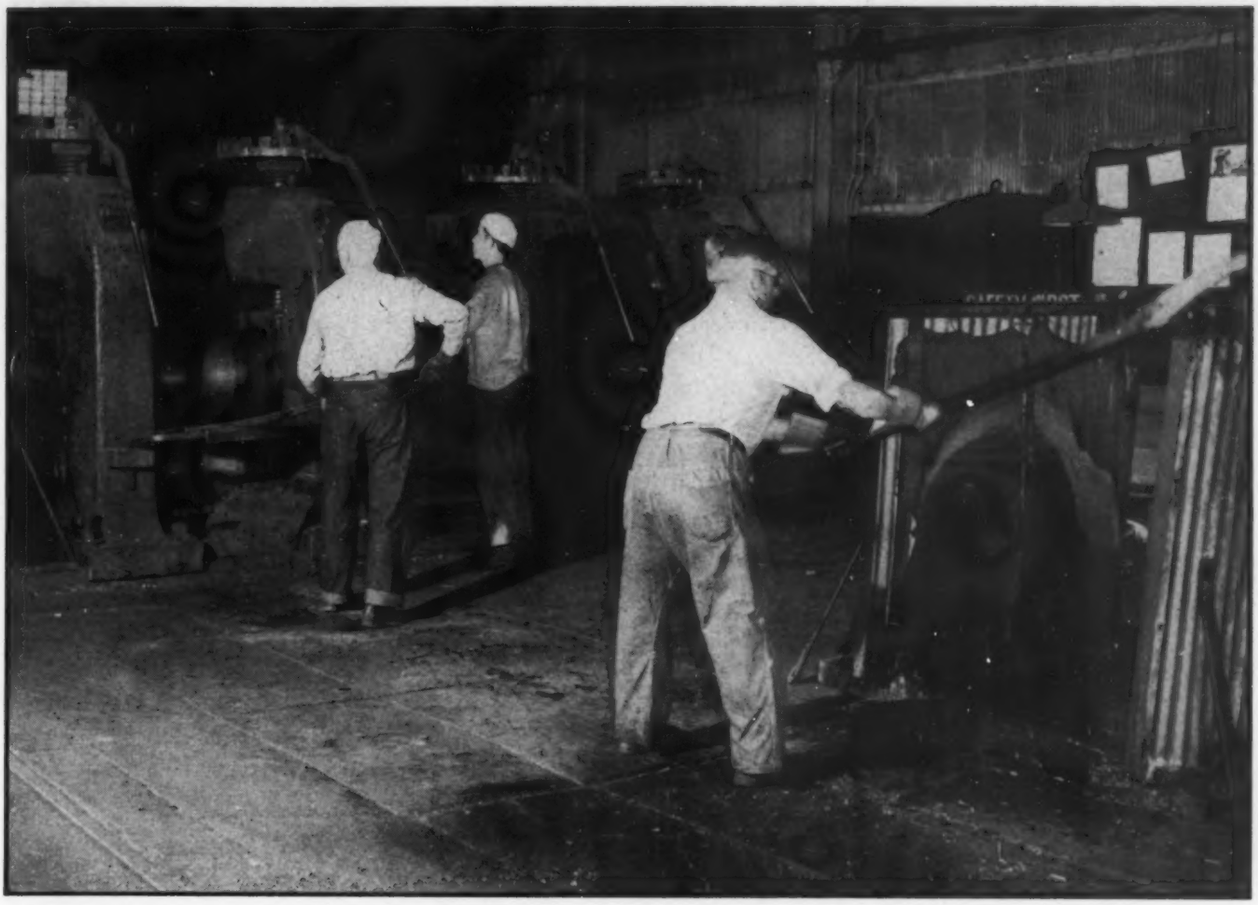


Figure 4 — The cross-cut roller is about to put a 14 ft radius in a 6 ft saw. The man in the center is operating the loose screw, while the one on the right is cleaning a blank by splashing.

very thorough and detailed, covering size, surface and condition. The rolling tolerance on 0.025 in. high speed is plus or minus 0.003 in., and on the molybdenum and tungsten types it is plus 0.001 minus 0.003 in.

Hack saw steel is graded according to size in shipment to the factory. To illustrate, No. 1 grade of 0.025 in. high speed runs from 0.022 to 0.025 in. inclusive, and No. 2 grade is from 0.026 to 0.028 in. inclusive.

CIRCULAR SAWS

The field of circular saws is a broad one in regard to range of sizes, grades of steel from which they are made, the methods of rolling them, and the applications to which they are put in industry.

We shall deal with wood cutting circular saws which are made from a 2½ per cent nickel, 0.75 per cent carbon steel in all sizes from 4 up to 84 in. diameter, and in special cases up to 110 in. diameter. Sizes up to 30 in. diameter are rolled in sheet form, thicknesses 0.065 in. and under being done in pairs, and over 0.065 in. in single sheets. This work is done on the 26 × 32 in. mill where our hack saw steel is rolled. For wide, heavy sheets on this mill we use either a 26 × 38 in. or a 26 × 48 in. finishing set.

The blanks for sheet circular saws are given a quick heat to 2000-2050 F, thoroughly cleaned in a scaling box under a stream of 300 lb of water pressure, and finished to size in one heat. For example, in rolling sheets under 0.065 in. thick, two blanks are taken from the furnace, cleaned, and delivered to the breakdown stand. The rougher puts one through the mill, and while the catcher is passing it back over the top, the rougher enters the other one. He repeats this operation with the two blanks and then matches them up, or puts one on top of the other, for additional reduction in his stand before transfer to the roller at the finishing stand. Sheet circle stock is rolled full to size in thickness. The sheets are put directly through a roller leveler and piled on the cooling bed.

Our practice is to roll sheet circles over 10 in. diameter in single width, 8 to 10 in. diameter in double width, and on down to 4 in. diameter circles which are rolled five wide. The sheet length is approximately 80 in. in order to give a uniform yield, such as 3-24 in. or 5-14 in. or 6-12 in. circles.

Figure 5 — Shearing a special 10 ft cross-cut saw plate "on the line" to a radius of 35 ft as illustrated, requires skilled experience.

All sheet circle stock is put through the gas fired, four-zone, continuous, annealing furnace, and then flattened, before it is punched or cut into circles. Sizes up to 18 in. diameter are cut out on punch presses, and over this size on a rotary size.

Circles over 30 in. and up to 46 in. diameter are rolled singly from quarter-octagon blanks on the only single-stand, two-high mill in the plant. This mill is non-reversing, with rolls 24 × 72 in., and a speed of 45 rpm. When rolling a quarter-octagon blank, the roller has to work for equal elongation of the four sides of his plate. He makes one pass straight into the mill, then turns the blank 90 degrees and makes two passes, followed by a 90 degree turn for each of the last three passes. The finished plate is reheated in the slow fire to 1300 F, and put in a press for flattening, after which it is placed in the cooling bed. Circle stock rolled on this mill is sent to the rotary shear for cutting-to size.

Circles 48 to 84 in. diameter are rolled on a two-stand, two-high, 30 in. mill, with roughing rolls 66 in. long and the finishing set 90 in. long. There is a motor driven screwdown on the roughing rolls, while the finishing set is controlled by a hand screw lever. The finishing rolls weigh 26,000 lb each. The top 90 in. roll is turned straight. The bottom one is tapered 0.015 in. starting 30 inches from each end of the roll.

Octagon blocks 5 in. thick, weighing from 110 to 550 lb, are furnished for these large circles, which run from 0.150 to 0.254 in. in thickness. The blocks are obtained by cogging and cutting 10 and 14 in. ingots into rectangular blocks, and then upsetting them into octagons.

These 2½ per cent nickel blocks are heated to 2100-2150 F and descaled on the two flat sides. The rougher takes them down to ¾ in. thickness or slightly under, turning them enough each time before entering for proper spread and distribution of stock. A reheat is taken on some plates before they are transferred to the finishing stand. The smaller, thinner circles in this stand receive five passes, accompanied by a 90 degree turn each time, then are held for gauge of thickness and measure of sides. If any additional passes are necessary, the heavy or short side is turned around for entry into the mill. The successful rolling of an octagon plate for an 84 in. circle on this 90 in. mill is an achievement calling for great skill, care and judgment. There

is a lift table on the delivery side of the mill, but only the conventional fore plate on the front side. The two men on the front side pull the sprawling hot plate, at times of unrecognizable shape, back across the top roll, and a practiced eye determines the way it re-enters the mill. The work on such a big plate is necessarily slow and two reheatings or more are required to get it down to size. In the final passes, the plate fills the entire roll.

All circles rolled on this mill are put back into the slow fire, heated up to 1400 F for flattening in the press, then laid down in the cooling bed.

Since we lack rolling facilities for the special sizes over 84 in. in diameter, this work is done for us by another company. We furnish the slabs and they are rolled into rectangular plates, followed by cutting to circular dimensions.

CROSS-CUT SAWS

Cross-cut saws are made from high grade 1.00 per cent carbon steel. One-man saws are produced in lengths from 3 to 4½ ft and two-man saws from 4½ to 10 ft. Some special ones have been made 12 ft and 14 ft and even 16 ft long.

The tooth edge of a cross-cut saw is thicker than the back edge. It is also always curved, whereas the back or thin edge may be curved or straight. The curve, or radius, in the cutting edge of a cross-cut saw varies according to pattern. We have twelve regular patterns, besides a number of special ones, which have a radius on the tooth edge from 14 up to 31 ft. The smaller the radius, the more sweep or curve the roller must put into his rolled saw plates.

Cross-cuts are rolled on a double-stand, two-high 18 × 34 in. sheet mill which operates at 58 rpm. Both stands are finishing mills, with top rolls turned straight and the bottom ones crossed ¾ in. As in conventional sheet mill practice, the top rolls are run by friction. The roller works with a tight screw on one side of the stand and a loose or open screw on the other side. On the delivery side of the mill, a stream of water plays across the top roll from one end of the roll, while another stream runs across the bottom roll from the opposite end. This water is an aid to the roller in controlling temperature of his rolls. Unlike other sheet or bar rolling, hot rolls in a cross-cut mill are a serious handicap to the roller because he cannot hold his plates in the working position on his rolls.

The 3 and 3½ ft one-man cross-cuts are rolled in double lengths, while the 4 and 4½ ft one-man, and all two-man saws are rolled in single lengths. This is done from curved, beveled blanks 6 to 8½ in. wide, weighing from 10 to 22 lb. These blanks are obtained by recogging 5 in. square, 125-150 lb billets on the 24 in. breakdown mill as follows: First of all, the roller slightly cocks his top 24 × 54 in. roughing roll by putting a ¾ in. liner on the breaker block opposite the driven end. Secondly, he puts a "peg" in the entering side fore plate 13 in. from the end of the roll affected by the liner. With these two necessary preliminaries attended to, the first billet enters the mill and receives five longitudinal passes in the roughing rolls, a pass in the edging stand, and returns to the roughing stand for entry into the rolls alongside the peg. The peg acts as a side guide in the sense that it keeps the billet from working over toward the middle of the rolls. This final pass produces a beveled plate that runs out in a curve with a radius of approximately 15 ft.

The cross-cut heating furnace is charged from the rear in heats of 25-30 blanks. They are placed on cross rails and brought up quickly to 2000-2050 F. The heater then delivers a blank to the scaler who removes the light, loose film of scale by splashing both sides in a scaling box of running water. The scaler then steps to the mill and enters the blank on the end of the roll that is raised by the loose screw, being careful in doing so to have the heavy side of the blank toward the elevated end of the roll. The roller gives the other three passes to the plate on the tight end of the roll, a fractional closing of the open screw preceding each pass. From the furnace to the cooling bed, the blank has passed quickly through the hands of skilled, nimble men. The curve has been reversed and what was the thick edge of the blank has now become the tooth edge of a future saw.

The cross-cut roller has to pay close attention to curve, tooth edge thickness, bevel, surface and flatness. The curve or arc on the tooth edge is governed principally by the manner of entry of the plate, and has to be as near as possible to the radius of the saw ordered. This is necessary so there will be a uniform thickness of the sheared saw plate. The adjustable screw and working position on the roll control the amount of bevel. The surface is kept clean by having blanks free from pits or any roughness, as well as by quick heating and good descaling. Flatness requires coordination of effort between the roller and his catcher, and care in piling.

The side of the roll regulated by the tight screw wears down ahead of the other end because of the 3 to 1 ratio of passes. When this occurs, the roller changes his set-up by opening up the tight screw and closing the open or loose one. With this quick change, he proceeds to finish on the other end of the roll. About 3,000 plates are made on each side of the roll.

Cross-cut saw plates are sheared to desired patterns and shipped in their natural or as-rolled condition. Shearing the plates is an interesting and important step in itself. This work is done on vertical type shears which can be set up with shims and knives for the various patterns. Saws up to 8 ft are cut on these machines and those of longer length are "cut on the line." This means marking the form of the pattern on the plate and shearing by eye to the lines shown. It is no mean accomplishment and takes a man long skilled in the game to do a machine-like job.

In the unfolding of this picture of rolling steel for saws, we have dwelt principally with one or two grades in the various shapes. This was intentional for the sake of clarity and simplicity. In closing, however, regardless of whether the saws are for wood cutting or metal cutting, the processing of the saw blanks, in general, is the same.

DISCUSSION

PRESENTED BY

F. J. HILLWIG, General Superintendent, Simonds Saw and Steel Company, Lockport, New York

H. A. CARTER, Superintendent, Roll Department, Bethlehem Steel Company, Lackawanna, New York

HENRY R. TURNER, Superintendent, Mechanical Department, Bethlehem Steel Company, Lackawanna, New York

C. P. HAMMOND, Superintendent, Rolling Mills, Atlas Steels Limited, Welland, Canada

R. K. GLASS, Assistant Chief Metallurgist, Republic Steel Corporation, Buffalo, New York

ERIC TAYLOR, Electrical Engineer, Atlas Steels Limited, Welland, Canada

J. LAURIE EDWARDS, Superintendent, Finishing Mills, Republic Steel Corporation, Buffalo, New York

F. J. Hillwig: If there is anybody who would like to ask questions on the rolling and processing of saw steel, I will try to answer them. I have here a cross-cut blank. The cross-cut saw rolling job is a very hard job to explain, so we thought we ought to bring this blank and rolled cross-cut plate. The 5 in. square billet that Mr. Britt told you about in the rolling of cross-cut saw steel goes through the 24 × 54 in. breakdown stand. It is then cut up into blanks, with the taper already in the blank. One side is about 0.380 in. thick and the other about 0.300 in. thick. The blanks are taken over to the cross-cut mill. The top roll is tilted on one end, the rolling on the tilted end being done with a loose screw, and on the other end with a tight screw. A blank is made into a cross-cut plate in four passes through the mill. During these four passes, the curve in the blank is reversed.

This saw is rolled 0.090 in. thick on the tooth edge and about 0.070 in. thick on the back edge. The roller aims to keep the sweep in the saw plate as near to the curve in the pattern as possible so that the gauge will be practically the same all the way along the tooth edge. This plate is marked 0.094 in. on one end, 0.091 in. in the middle, and 0.093 in. on the other end, and 0.074 in. on the back edge. You will note the plate is very flat. I don't know of anybody in the saw business today who is making cross-cut saws the way we do. Years ago it took fourteen passes to roll these cross-cut plates; today we roll them in four passes. It used to take fourteen men; now it requires only eight men.

In the rolling of big circular saws, the ingots are forged and cut up into blocks, then reforged, by upsetting, into octagon blocks. There are two reasons for that; the principal one is scrap loss. This amounts to about 45 per cent when rolled from a rectangular block, whereas from an octagon block the scrap loss is only 20 per cent.

The hack-saw is an entirely different proposition. I think that it is one of the hardest things there is to make, due to the fact that the surface of the hack-saw has to be perfect; as you all know, there is no grinding whatsoever on the hack-saw blade. The scale must not be broken on the hack-saw blade. The thickness of the scale when the peg comes out to set the teeth would make a difference in the set of the saw.

The rolling of band saws is a very particular operation. I might take, for example, a 12 in. band saw rolled to 0.090 in. thickness by 46 ft long. That saw, when eventually finished, is 14 gauge, or 0.083 in. thick. The plates must be absolutely clean when so little is allowed for grinding.

H. A. Carter: On wide band saw steel, you roll through No. 3 stand, which is a three-high stand, with both top and middle rolls friction driven. Why do you do this and how do you do it?

E. J. Hillwig: It is very easy. Naturally a man from a strip mill would think the band would stick. We take a ¾ in. blank for the 12 in. bandsaw, and we break it down on our roughing stand, then into the No. 2 stand, then to the three-high No. 3 stand. It enters in the neighborhood of 0.140 in. thick. The first pass is through the bottom, the next, through the top, then through the bottom again, then through the top, and from there over to the two-high mill. Of course, you have to keep grease on it. The object of this three-high mill is really to do extra work and thereby, relieve the amount of work that would otherwise be necessary in the two-high finishing mill. Does this answer your question?

H. A. Carter: Yes. Regarding the circular saws, the paper stated that on circular saws, you use octagon shaped slabs and keep turning them, around and around in the rolls. What type rolls do you use in this operation? In the strip mill, with a fish-tail on strip, we are liable to spall the rolls when such a small surface comes in contact with finishing rolls.

F. J. Hillwig: The circular saws are octagon-shaped, right up to the finishing pass, and we have had no trouble in spalling rolls. The rolls are chilled iron.

H. A. Carter: On cross-cut saws, the tooth edge is thicker than the other edge. Also, the back edge of saws are made either straight or curved. I can understand how a curved back is made but how do you make those straight backs? Can you roll them straight?

F. J. Hillwig: No, it is a straight back saw, not a hollow back saw. All saws are sheared, after they are rolled to desired shape.

Henry R. Turner: The rolling of the blanks for these saws follows very closely standard sheet mill practice. I am interested in the tight and loose side of the mill. In sheet mill rolling of low carbon steel, we

would develop camber and pinchers with a tight-loose screw set-up.

F. J. Hillwig: Is that because the mill is not hot enough before you start to roll?

Henry R. Turner: Some of it comes from that sort of a condition.

F. J. Hillwig: There is no question about it on rolling hack-saw steel, four in a pack. We use a warm-up run on a heavier gauge before we start on a lighter gauge, or we would have the same thing on all bands. There is no question but that when the rolls are not up to heat, the metal will go to the center, and that probably will explain the condition you asked about.

Henry R. Turner: Do you have the same condition with alloy steels?

F. J. Hillwig: Yes.

Henry R. Turner: What do you do about the cross-cut saw?

F. J. Hillwig: The only place we use the tight and loose screw is on the rolling of cross-cut saws.

Henry R. Turner: Do you have a lot of trouble in that?

F. J. Hillwig: No. The whole trick in rolling the cross-cut saw is the way the man enters the cross-cut saw. If he is just a little bit off, he can throw this curve way out of shape.

C. P. Hammond: Are the band mill and the cross-cut mill engaged exclusively in the work described or are they adaptable to other types of material?

F. J. Hillwig: On these two mills, we can roll sheet steel or band-saw steel or any kind of metal strip.

C. P. Hammond: Will you explain briefly how you cross the rolls, and why?

F. J. Hillwig: A $\frac{3}{4}$ in. cross in the middle is simple; when the roll turner turns the roll he will turn the top roll straight, and then he turns the bottom roll straight. He sets the top roll on top of the bottom roll and he will take a scale and square it up to the neck of the top roll. He will move that out three-quarters of an inch; that's what we call a three-quarter cross. The idea of that is that when the rolls come up to temperature they are parallel. If you don't cross them, practically every sheet would go through in the neck of the rolls. Not only that, but you would have light centers.

C. P. Hammond: Do bands receive any further treatment after leaving the mill?

F. J. Hillwig: Yes, the band-saw goes to the Fitchburg factory, where it goes through the hardening and tempering process. Then there is a $\frac{1}{16}$ in. cut taken off one edge. Next, it is toothed, ground, and braised; then it has to be polished, set, and filed.

C. P. Hammond: Would you tell us how a hack-saw sheet 0.025 in. in thickness is cut up for saws?

F. J. Hillwig: Some sheets are sheared $20\frac{1}{8}$ in. wide and $50\frac{1}{2}$ in. long. Sheets of this length are in four multiples of $12\frac{5}{8}$ in. At the Fitchburg factory they are first cut into the $12\frac{5}{8}$ in. lengths, then set to the automatic shear. The shear takes off $\frac{1}{8}$ in. to square up the sheet before cutting it into $\frac{1}{2}$ in. wide strips. A sheet $20\frac{1}{8}$ in. wide and $50\frac{1}{2}$ in. long makes 160 hack-saw blades. A sheet $20\frac{1}{8}$ in. wide and $53\frac{1}{2}$ in. long, which is five multiples of $10\frac{5}{8}$ in., will make 200 hack-saw blades. The strips are jigged and set on their edge, and then the miller or cutter runs across them and mills the teeth in the whole block at once.

C. P. Hammond: On the cross-cut mill, does the roller use any guides?

F. J. Hillwig: No, except on the 16 foot saw where he might put up a guide.

C. P. Hammond: You mentioned that curved, beveled blanks were used. Could a straight, beveled blank be used?

F. J. Hillwig: I wouldn't say no because you have to start with your blank in the method described in order to reverse your curve. Take this blank, for instance; on the first pass, the reduction of that blank is about 35 per cent; the reduction on the next pass is about 33 per cent, and then, the last is a 26 per cent reduction.

C. P. Hammond: About how much taper is there on a cross-cut saw when it is finished?

F. J. Hillwig: This saw is finished at 14 gauge, which is 0.083 in. and is 18 gauge in the back, which is 0.048 in.

C. P. Hammond: Is your company still run by the founders of the company?

F. J. Hillwig: It is.

R. K. Glass: When you refer to modern methods on crossing rolls, I noticed that Mr. Britt related that on band-saws he crossed them half an inch and on hack-saw blades he crossed them an inch and a half.

F. J. Hillwig: The hack-saw rolls get a good deal hotter than the band-saw rolls; therefore the greater degree of cross.

R. K. Glass: In pack rolling, the inside sheets retain their heat longer and elongate more than the outside sheets in the pack. Is there any difference in that?

F. J. Hillwig: No. We change the sheets in the pack twice.

R. K. Glass: I suppose it would be interesting to the men that operate modern high speed sheet mills, to know whether or not in your high speed, particularly, your cobalt steels, you have to stop during the critical points of the steel?

F. J. Hillwig: Yes, we have to stop and re-heat. On pack rolling, what we try to do, when we roll hack-saw steel, of say 0.025 in., is to run down to about an eighth of an inch, so we get four blanks out of that one sheet. The whole pack will then be the same gauge to start with after matching up.

R. K. Glass: How long does it take to produce a roller or a shearman?

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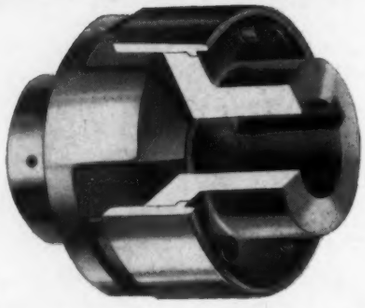

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F. J. Hillwig: A roller in a sheet mill has to go in and serve his apprenticeship. He generally starts, so to speak, at the bottom of the ladder. He goes up to be a scaler. When he is roughing down, he will change off with the roller, and in that way he gets his hand in on the finishing. A shearman on a cross-cut saw is a different proposition. If you take a look at this slate and notice the curve on it, as Mr. Britt mentioned anything over 96 inches, has to be sheared to a line. Now, imagine a straight shear blade 28 inches long with the man starting on that end, and a helper guiding that end, and another man back here. He has to swing his body with that line, and the worst part is where his cut stops and the next one starts as he moves along the blade. The reason why we had to start curving in this way was because of a fellow by the name of Gibbs, who made what we call the Gibbs jointer. It is a tool that holds a file, with which each tooth of the tooth edge of the saw is made even before starting to file the saw. When you have a man shearing along a line, if you have a little hollow spot, when you come along to that spot with the Gibbs jointer, the file will hit it like this. The shearing of a cross-cut saw is a real hard job if a man has to shear it to a line.

R. K. Glass: Do you have to use rolls of different material?

F. J. Hillwig: No. On these rolls, we use what we call "chilled rolls."

R. K. Glass: Is no hard iron used in the rolling?

F. J. Hillwig: We use alloy rolls in our 16 in. mill.

Eric Taylor: You said that you have electrically driven mills, do you use a-c motors throughout?

F. J. Hillwig: Yes.

Eric Taylor: I would also like to know what horsepower you use to drive these mills?

F. J. Hillwig: The band mill is a 750 horsepower motor with a continuous drive of 22 strands on an 86 ton flywheel. The 24 inch break-down mill has a 300 horsepower motor. The 30 inch mill has a 300 horsepower motor also with a single shaft. The cross-cut mill has a 200 horsepower motor; the sheet mill has a 200 horsepower motor, and the 16 inch mill has a 300 horsepower motor.

J. Laurie Edwards: When you use the 2050 or 2100 F temperature, how long does it take you to get up to that temperature?

F. J. Hillwig: An octagon block for circular saw steel, 4½ inches thick, takes about an hour or an hour and fifteen minutes. An ordinary sheet bar ⅜ in. takes about 15 minutes; we use a slow fire as the furnace heats up to the necessary temperature, so the heating will not scale the sheet.

J. Laurie Edwards: Do you always take the blocks up to a temperature of 2050 or 2100?

F. J. Hillwig: It depends on the grade of steel we are rolling.

J. Laurie Edwards: How about the higher alloys?

F. J. Hillwig: No, on the higher alloys we pre-heat.

Bar Mill Housings and Equipment

. . . . the use of movable spare housings and spare stands has increased production through a decrease in roll changing time . . . .

by J. N. Imel

GENERAL MILL FOREMAN

JONES AND LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

▲ IN order to maintain a capacity tonnage bar mill it is essential to have housings, rest bars and guide boxes and guides that can be handled easily, adjusted quickly, and maintained efficiently. Through past experience it has been found that roll crews adapt themselves better to equipment that is simple in construction. Bar mills that are rolling to capacity have minimum delays in changing rolls and passes because of efficient equipment. Reduced delays are the result of having equipment that can be changed and adjusted with speed and accuracy.

Equipment varies as to mill conditions and construction, but it has been proven conclusively that where it is possible to simplify equipment for rapid changing, production will increase and the initial cost of the equipment will be absorbed in a short period of time through increased tonnage produced.

To give a concise description of the rolling mill equipment that we have found to be the most efficient for our type of mills it may be well to start as if we were setting up a housing as we do during a roll change. See Figure 1. The housing is constructed of cast steel. In the past, most bar mill housings were made of cast iron mainly because iron afforded the cheaper casting. However it was found that cast iron construction was very difficult to maintain, in that certain wearing surfaces could not be repaired easily, and after repairs were made this portion would not stand up. Constant breakdowns and extremely heavy repair costs were continuously encountered. Steel, in contrast, will withstand greater shocks and has the strength to stand up to production requirements. Furthermore, it can be easily repaired by electric welding and made as strong if not stronger than the original casting.

The housing is designed with a solid base connecting the four upright posts. This solid base construction tends to hold the housing together firmly and reduces "roll spring."

The foot or base is slotted with a taper to fit over an opposite tapering on the bed plate. Each foot of the housing is drilled for two foot bolts making a total of eight for the housing. These bolts are hooked on the bottom so that they can be pulled up tight against the bottom rib of the bed plate. As the housing is pulled down by the foot bolts, the tapered surfaces work as a wedge effect and always keep the housing firm against the bed plate. This type of housing is stationary and never moves. However, on some mills the same type housing of solid base construction is used but instead of being bolted down permanently to the bed plate, slips over four permanent bolts fastened to the bed plate and these bolts are slotted for keys, as shown in Figure 2.

These movable housings are lifted off the bed plates when desired, moved to spare stands and replaced with similar housings already set up. This spare set housing arrangement is more desirable as rolls can be changed at the spare stands while the mill is rolling. In this way, delay time is reduced to a great degree; as much as 80 per cent of roll change delays are reduced. Some of the older type mills that formerly used permanent housing have changed to spare set equipment and the expense of installation has been paid for in a short time by reduced delays and increased tonnage.

The housing windows have ¾ in. hard steel liners or wearing plates inserted on each side, as shown in Figure 1. These plates are held in place with countersunk bolts "C," and can be quickly replaced when they show any signs of wear. In the past, most housings were not equipped with these wearing plates, requiring the surface of the housing windows to be built up periodically in order to maintain a tight bearing. Tight fitting bearing chucks are very essential in holding the roll firm and in line. During roll changes it is the duty of

Presented before AISE Annual Spring Conference, Chicago, Illinois, May 7, 1946.

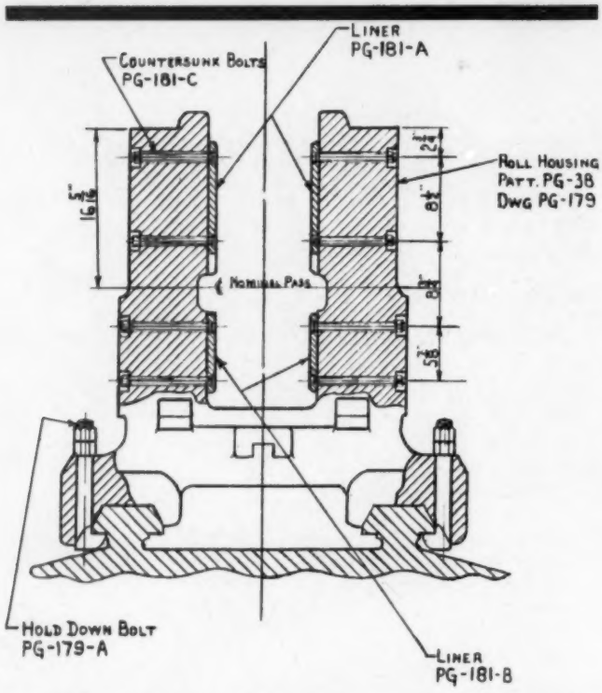
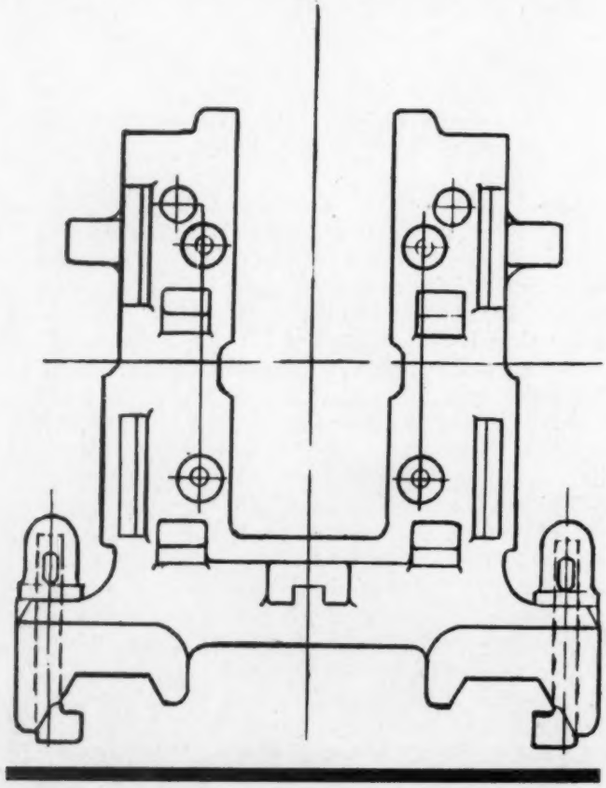


Figure 1 — The solid base construction of the housing reduces roll spring. Foot or base is slotted with a taper to fit over an opposite taper on the bed plate.

the crew to keep these plates well lubricated in order to reduce wear.

The bottom roll is held in place by four hold down bolts, shown in Figure 3. These four bolts are connected to a floating plate or channel between the base legs of the housing and are hooked on the top end. The four bolts are fastened to the plate by keys, and run up through each leg of the housing through slots cut out in liner plates. The hooked end of the bolts fits over the top of a roll rider which runs across the neck of the bottom roll. The bottom floating plate is also connected to the housing by two adjusting screws on each side. These adjusting screws run up through special nuts that are welded on the outside of the housing, and the screws are flanged at the base and set in cups that are welded on the floating plate. As the adjusting screw is turned, the nut in the housing permits the screw to work up or down as desired and the cup on the floating plate holds the screw to the plate. As the screw works up or down, the floating is lifted by the two side screws and the four hold down bolts also work up and down along with the floating plate and either tighten down on the roll rider or loosen it up as desired. Two or three complete revolutions of the screw are sufficient to loosen the hold down bolts on the roll rider in order to remove it by sliding the rider out over the roll neck. The bottom roll in this type of housing is held stationary. The only adjustment in raising it is to place liners under the bottom bearing chuck.

Figure 2 — This type housing has four permanent bolts fastened to the bed plate which are slotted for keys.



The top roll is held in place by a center carrier or support bars shown in Figure 4 running through slots cut in each housing post on each side of the housing. These bars are made from high carbon steel or a suitable alloy in order to have sufficient spring and strength so that they will not bend when considerable pressure is applied. A center bearing or top roll carrier with a grooved slot or keeper, cut in the base, fits neatly over this carrier bar and holds the top roll in place. These carrier bars are hooked on each end and fit through slots or holes in the housing and then through eye bolts on each side of the housing. These eye bolts can be pulled up or down, raising or lowering the top roll as desired. The top roll also has two top bearings and breaker blocks on each end of the roll. These breaker blocks are made of cast iron and afford a breaking point when a serious cobble or collar on the roll occurs.

The housing cap is then put in place, as shown in Figure 5. It is also of solid construction and made of cast steel. It is held in place with four heavy forged cap bolts with slotted eyes for keying down. It is the preference of most roll crews to have housing caps that are keyed in place rather than bolted down because of speedy adjustment. Keys are set faster and hold the cap more secure than the old type bolts and nuts. The bottom of the cap and the top of the housing are cross grooved with a wearing space to insure a solid firm fit and this prevents the cap from moving in any direction. The feature of a wearing space has been found to have saved considerable maintenance costs over the old off-set cap as the off-set cap type was constantly being repaired on the wearing surfaces.

The roll adjustment is done with two head screws on each side of the cap, and the center carrier hanger bars that run through the housing. All adjustment is done on the top roll only, as was stated previously, the bottom roll is stationary and can only be raised and lowered by placing liners under the bottom bearing.

The head screws push the top roll down or the center carrier bars can pull the top roll up whichever is desired. This is advantageous over bottom roll adjustment housing as the entire mechanism of the housing can be easily seen and it takes the working adjustments away from the base of the housing and from all the water and scale which are always injurious to working parts.

In certain housings, where the location and close clearance prevents the use of center carrier bars, such as a roughing train, "hydraulic center balances" are used, and one is illustrated in Figure 6. The balancer is constructed in two intermeshed parts, the top roll carrier, and bottom roll rider. The top carrier is made of cast steel and bored on both sides to form two cylinders of 3 in. diameter. The bottom roll rider has two pistons fitted with hydraulic leather cups that slip into the two cylinders in the top carrier. The length of the cylinders being 2¾ in. will permit a stroke of 2½ in. There are four limit pins running through each end of the entire balancer which prevent the pistons from coming out of the cylinders, but still enable the stroke to travel 2½ in. On the outside of the balancer top and bottom, are fitted fibre strips which act as a bearing and ride the top and bottom roll necks. Oil under 300 pound pressure is fed into the bottom half of the balancer under each piston through a ⅛ in. line. The oil pressure is produced at a receiving tank located at a convenient location away from the mill proper. The receiving tank is filled, half with air and half with oil, the air cushion is increased by an air compressor. A constant pressure is maintained at all times against the top roll during rolling, and pushes down against the bottom roll acting as a wedge prying the two rolls apart. When it is necessary to make adjustments or to close down the top roll, the pressure is reduced by shutting off the valve on the main oil pressure intake line and opening a bleeder valve that is situated between the main line valve and the balancer, usually at the base of the housing. However during normal operations it is not necessary to shut off this valve to pull down on the head screws when closing down on the top roll. The pressure exerted by the head screw on the top roll is sufficient to overcome the pressure of the balancer.

The housing is equipped with fabric bearings in all finishing stands and in most cases in the roughing stands. However it has been found that in some of the slower speed roughing housings, non-metallic bearings do not stand up as well as a metallic bearing, due mainly to the slower speed. The only lubrication used on the non-metallic bearings is water, which is brought in on the bearing on both sides of the roll neck, between the bearing and the roll rider. On week-end shutdowns, it is essential that a small amount of oil is run on the roll neck as it is making its last few revolutions before shutting down. This precaution prevents the fabric bearing from drying out and freezing on the roll neck, causing trouble in turning the mill over in starting up.

The rest bar is fitted against the housing and held in place by two bolts (see Figure 7). The heads of these bolts fit into slots machined out of the sides of the housing. The rest bar is a very important part of the housing equipment, and here again the type and design vary in a great many cases with the type of mill and the purpose and flexibility desired. The rest must be set

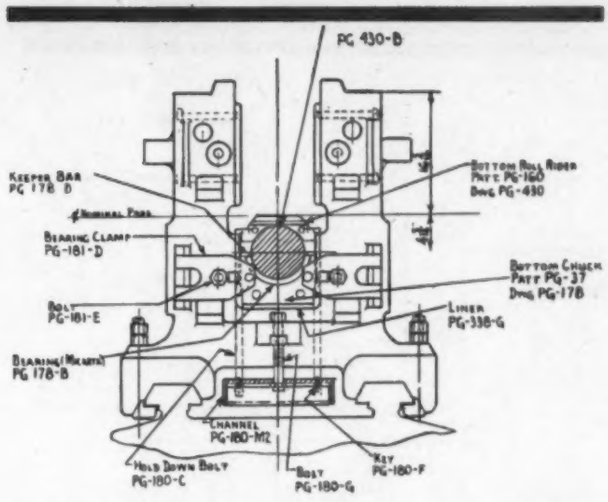


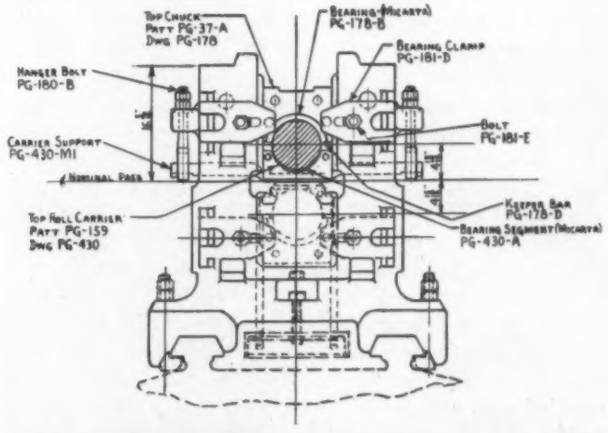
Figure 3 — The second stage of the housing assembly consists in setting the bottom roll in place.

solid and also easily adjusted because a faulty or carelessly set rest bar will cause a great amount of trouble and considerable off section material to be rolled. It is a part of the rolling equipment that the roll crews seem to dislike to adjust or move, but instead they will place liners under guide boxes or remove them when it is necessary to raise or lower the guide box unless the rest is made easy to adjust.

At the point where the rest bar fits against the housing slots, one side of the rest bar is dovetailed or tapered out and the housing slot tapered in (see Figure 8). This idea tends to pull the rest into a level position when the bolts are tightened up.

On each side of the rest bar running in a vertical position to the rest and connected to each side of the housing are hanger bolts used to raise and lower the rest bar when desired, as shown in Figure 7. The action in moving the rest is to loosen the clamp bolts on each side, first setting the rest free from the housing then pulling up or down equally on each hanging bolts to get the proper adjustment.

Figure 4 — The center carrier bar holds the top roll in place.



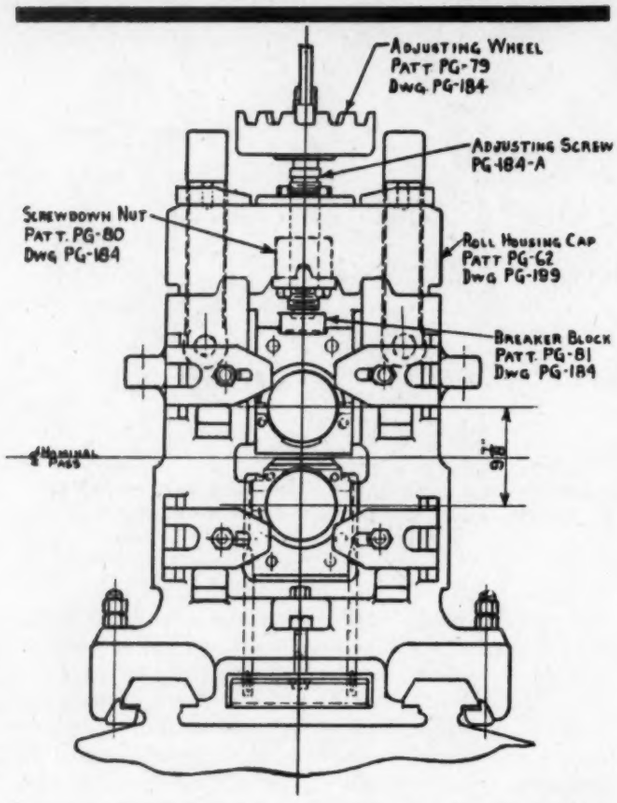


Figure 5 — The housing cap is keyed in place so that speedy adjustments may be made.

The surface of the rest bars differs as to the position used on the housing. Entry or receiving rests are usually tapered on the surface closest to the roll and the guide box fitted on this type rest has an opposite taper. This is done to keep the box from pulling into the rolls and acting as a wearing surface. Delivery rest bars have this taper on the heel of the rest or the surface farthest from the roll, and acts in the same respect as the entry box in preventing the box from being knocked off the rest or loosened easily.

The different types of mill construction necessitate using different type rest bars and guide boxes. Most rests are grooved through the center to accommodate a bolt running through the center of the guide box and bolted on the bottom of the rest. In some cases where close clearance prevents the use of a wrench, guide boxes are keyed to the rest bars. The keys are driven through tapered slots in an overlapping guide box, both the box and rest having different tapered surfaces. Most mill crews approve of the key type box because of fast setting, as a key can be driven with greater speed than the tightening of a bolt. However, keys will work loose easier than bolts, and it is my opinion that where bolts can be used they are preferred and afford a more solid box. Another type of rest and guide box is bolted down from the top. This box is used on a slotted rest but the guide box is made so that two bolts pass through lugs on each side of the box and the nuts are on top of the rest instead of on the bottom. This type of rest and guide box is preferable. It tends for solid and fast adjustments.

The surfaces of the rest bars have been designed

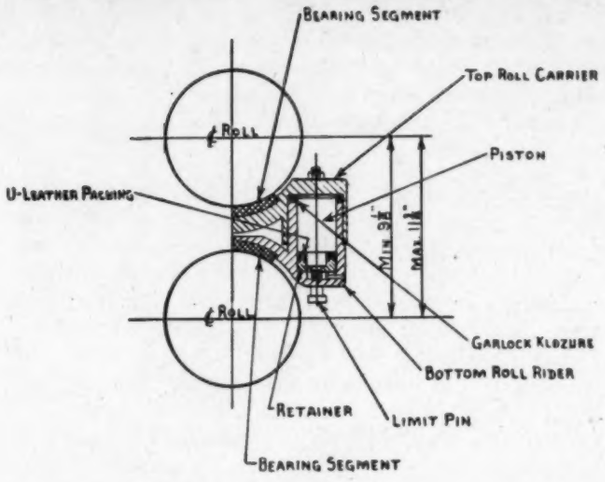


Figure 6 — Hydraulic center balances are used where close clearances prevent the use of center carrier bars.

differently according to the type of mill and the job to be done. In most cases the design to keep the guide box secure and in a permanent position but still be such that the guide box can be moved or set easily.

The snug off-set type rest of Figure 9 is designed by cutting an off-set down through the middle of the rest which allows the guide box to fit neatly against each shoulder. This rest can be used on either as a delivery or entry rest, and can be inter-changeable and only one type rest is needed for the entry and delivery side of the housing. However, after considerable wear the box will fit loosely and the rest or guide box will have to be built up accordingly to insure the original tight fit.

The perfectly flat rest, shown in Figure 10, is used to advantage in many mills where fast adjustment is required. This rest is perfectly flat with no off-set and used mostly with overlapping guide boxes.

The "step" rest bar of Figure 11 where one off-set is made on the rest bar can be used either for entry or delivery boxes. However, when used as an entry rest the step is off-set on the front of the rest bar preventing the box from being pulled into the roll and on the heel of the rest on the delivery side to prevent the box from being knocked off the rest.

Other rests used are the dovetail type seen in Figure 12, and key bolt slide type rest used mostly with guide boxes with top bolt adjustment, and shown in Figure 13.

The wedge bolt guide box used on a flat rest bar has become very popular recently, especially in roughing trains where close clearance is a handicap. The main advantage is the top bolt adjustment and the quick loosening of the wedge when it is necessary to adjust the box. Only one or two turns are required on the nut and a slight tap on the top of the nut will drive the wedge away from the rest bar and the guide box can be moved easily to any position desired. The "dovetail" rest can be used either on the entry or delivery side of the housing. And some boxes are overlapping with a wedge bolt top adjustment as shown in Figure 14.

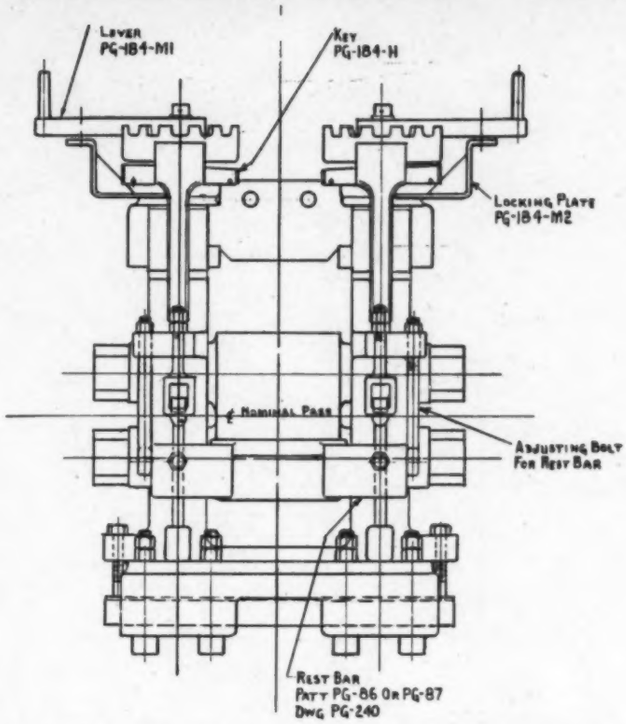
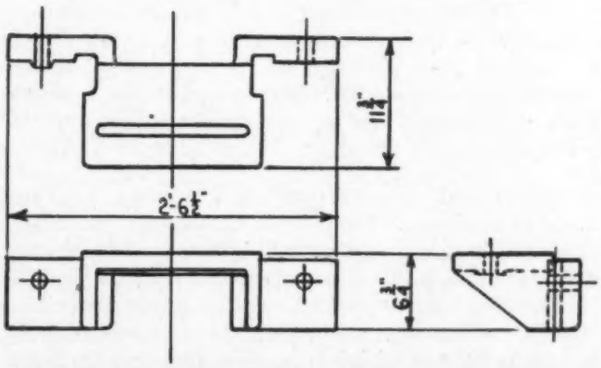


Figure 7 — The rest bar which is fitted against the housing is held in place by two bolts.

However most of the dovetail type are used to greater advantage as an entry box, such as Figure 12.

Recently the rest that has become most prominent due to least maintenance and which is also the most solid fitting over a long period of time is the binder type of Figure 15. This rest is machined off through the center with a 45 degree changer and the box in a similar fashion. However, the box is machined so that it will not fit to the complete bottom of the chamfered rest, but a space is left between the bottom of the box and the rest of about ⅛ in. As the box is pulled down tightly in place the two chamfered surfaces act as a wedge and keep the box always in a solid position. Also as the chamfered surfaces wear the space between the

Figure 8 — The rest bar is so tapered that tightening the bolts tends to pull the rest into a level position.



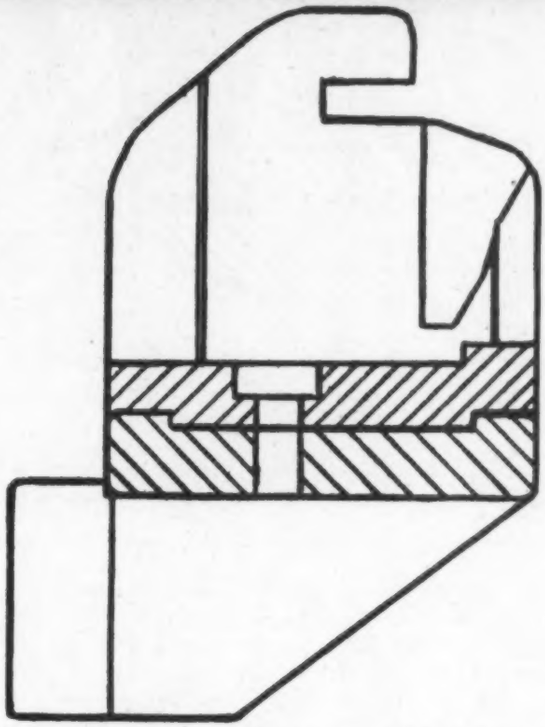
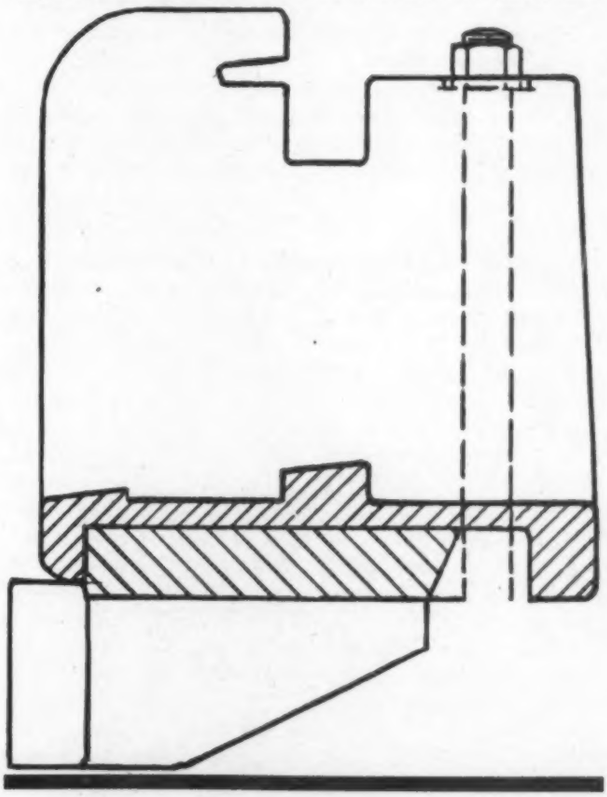


Figure 9 — Snug off-set rest bar and guide box.

bottom of the box and the rest being about ⅛ in. allows wearing space.

But as stated before, equipment that seems satisfactory at one plant may prove quite the contrary

Figure 10 — Arrangement of flat rest bar and guide box.



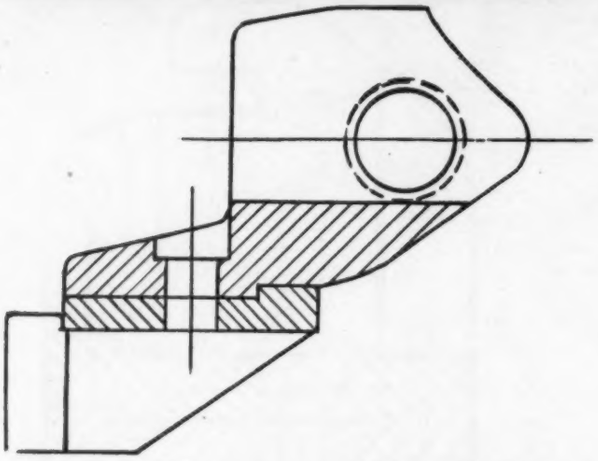
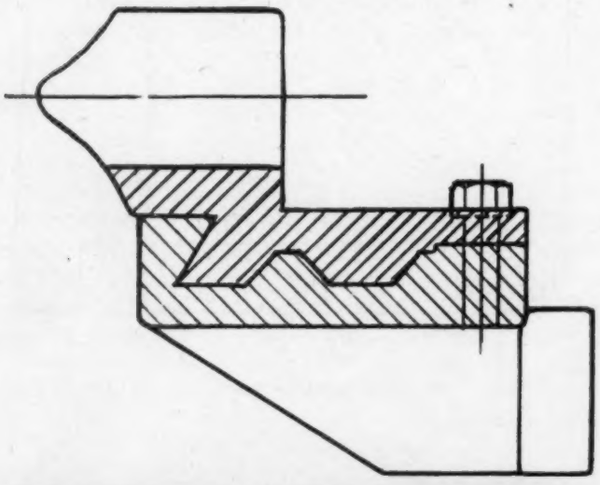


Figure 11 — Arrangement of step rest bar and guide box.

elsewhere, or even in different mills in the same plant.

Guide boxes used are made to fit the mill type. On our smaller mills, entry boxes are open boxes with side guards. As the size of the mill increases, regular entry guides set in an adjustable box are used. Set screw slots are put in the top of the box to accommodate two set screws to hold the guides tight in the up-right position on each side of the box, it is tapped in two places at the front and rear of the box to adjust the guides in a side motion. However, on the entry of the finishing sets, screw boxes are used; these are similar in construction to the entry boxes in the roughing mill, except one side is equipped with a double threaded nut welded into the box and a double screw. The screw is flat on the inside and where it fits against the guide, it is made large enough to cover as much of the surface of the guide as possible in order to get a full bearing. The inside of the screw is made square in order to fit a screw bar or lever into it, and as the lever is turned, the screw works in and out moving the adjustable guide as desired. The opposite guide is held in a stationary position by set

Figure 12 — Dovetail rest bar and guide box.



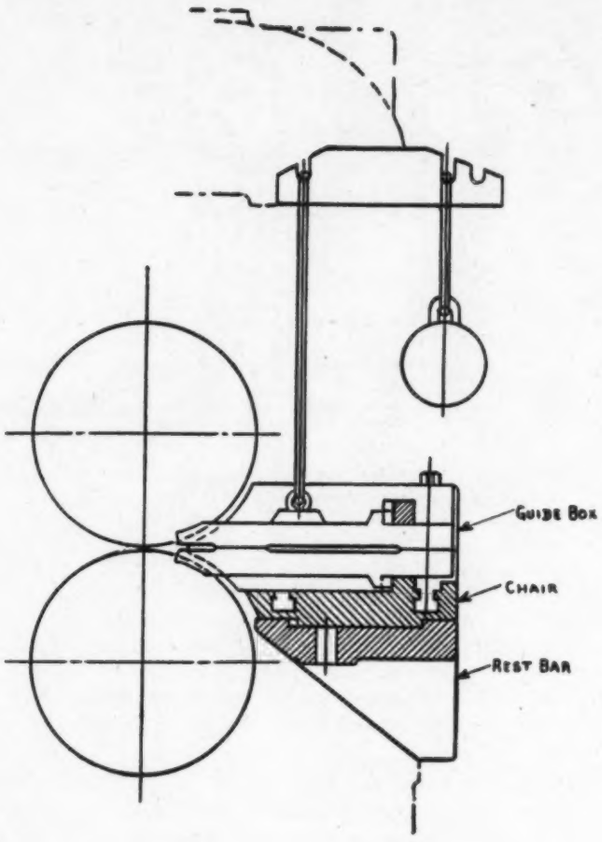


Figure 13 — Key bolt, slide type, rest bar and guide box.

screws. This type of box is advantageous in that a tight guide can be used to hold up the bar from the leader to the finishing set, and a closer and more uniform section can be maintained. Periodic inspection of guide boxes must be made for wear, as the heel of the guide will wear on the base of the box causing the guides to line up unevenly; if this condition is not corrected it will cause guide scratching, flat bars, overfills or shearing on the bar.

The delivery guide boxes in most cases are made to accommodate hanging guides. However, in some cases we are still using delivery guides that are keyed and wedged into place. The hanging guide box is either keyed to the rest bar or bolted down as conditions permit.

Guides used on both entry and delivery sides are made to conform to the pass design and section rolled. In some cases such as when rolling flats or angle shapes, a straight flat guide can be used to better advantage. It has been our experience that a guide shaped to conform to the section entering the rolls will hold the bar up better and with less pressure than one that does not conform to the shape of the bar. The firmer a bar

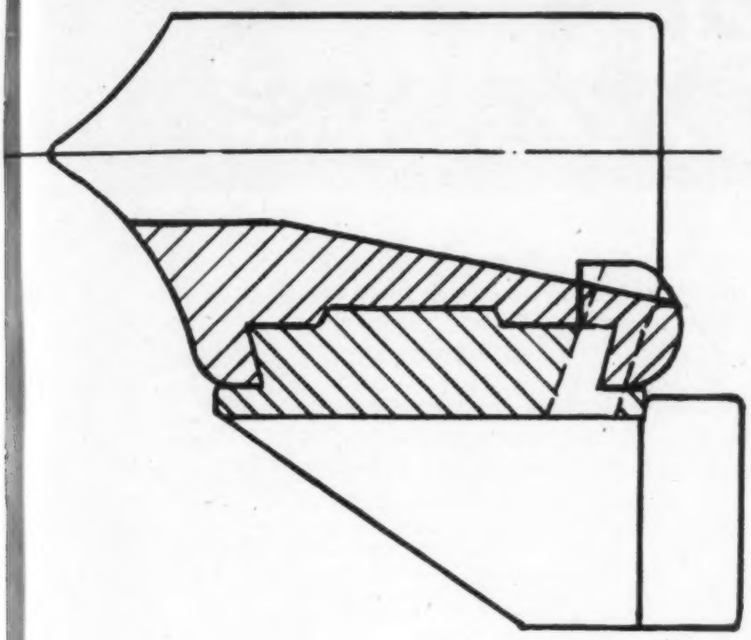


Figure 14 — Arrangement of outside dovetail, key type, rest bar and guide box.

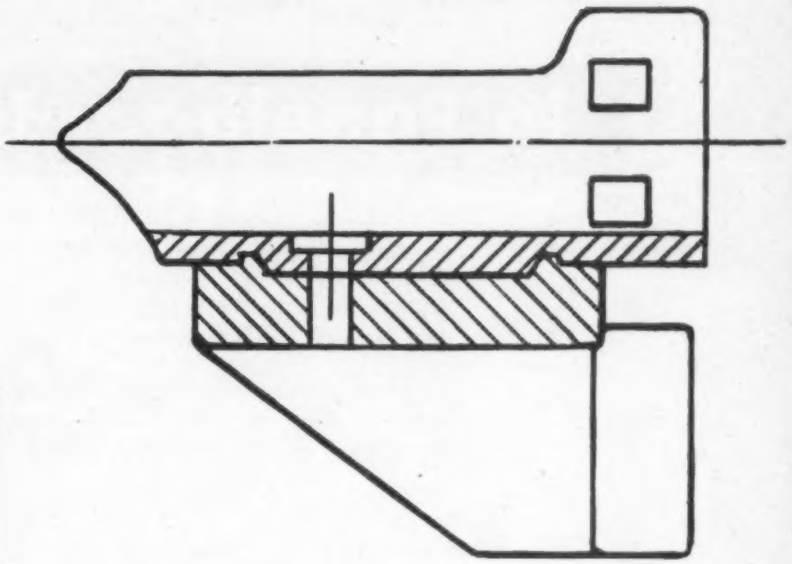


Figure 15 — Binder type rest bar and guide box.

is held, as it enters a stand, the more uniform and closer the size can be rolled. Material used to make the guides is an important question and there will be no attempt to touch much on that subject because it is too extensive; we might state, however, that we have used alloy chrome nickel guides in roughing and finishing mills to great advantage and found the life of these guides was greatly increased compared with white metal or cast iron previously used. Also we have welded hard metal on the surface of our guides to increase the life.

The desired length of delivery guides is determined by the work the guide is to do. If it is used only to strip the bar from the roll, and no twist is required, it may be made short so there is not too much surface for the bar to rub against, as in the case of hanging guides. However, the length of twist guides is determined by the degree of twist needed and the space needed to turn the bar up in order to enter it into the next stand.

In the case of entry guides, a long guide need not be held against the bar as tight as a short guide in order to do its work. Therefore, the longer guide reduces the possibility of guide cutting or shearing on the bar.

The space figured between the top and bottom delivery or the entry guides is $\frac{1}{8}$ in. to allow for wear. It is our idea to run sufficient water on the guide and guide box while the mill is operating to keep the guides cool. Hot guides will tend to pick up scale accumulations and cause guide cutting.

The main principle in keeping good guides is to have them squared off and all surfaces ground before they are put on the mill. We have a central guide shop that is equipped with a shaper grinder. All finishing entry guides from all the mills are sent to this shop direct from the foundry where they are paired off by the grinder and marked as to sets. Each pair of guides are ground together to make sure that the grooves are centered and the guide width is the same. All guides are ground and leveled up on all surfaces as well as within the groove itself, if it will permit and is not too small to grind. These guides are wired up and kept in pairs and sent to the respective mills.

It may be felt that this process adds considerable cost to making guides and is hardly worth the expense, but we have found that with guides that are trued up and paired, less trouble is encountered by the mill crews and less material and less mill delay is encountered. The reduction of scrap and off section material alone will pay for the additional expense in a short period of time.

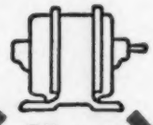
Save Space · Save Money-

in Panelboards and Switches

You can get fuller use out of every switch or panelboard on Motor Circuits by Installing Fusetrons. The tremendous time-lag of Fusetrons permits them to hold starting currents or other harmless overloads. Hence they can be used in sizes nearer to the actual *operating* load of the circuit.

Ordinary fuses have little time-lag. To keep them from opening on starting currents they must be used in sizes much larger than the actual operating load. This means that OVERSIZE equipment must be provided for them.

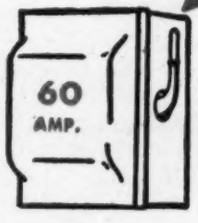
To get a picture of what Fusetrons can do for you let's take a 15 amp. motor as an example. Then you can figure the advantage of installing Fusetrons on all your circuits



15 amp Motor

With ORDINARY FUSES

a 60 ampere switch is commonly installed because 45 ampere fuses must be used to hold the motor starting current



OVERSIZE Switch or panelboard

PROPER SIZE Switch or panelboard

With BUSS FUSETRONS

a 30 ampere switch is installed because on normal installation, 15 ampere Fusetrons can be used. They will hold the starting current of the motor

Think What Fusetrons Can Mean to You in Saving Space, Time and Money

On NEW installations

You can use Fusetrons in sizes smaller than would be possible with ordinary fuses. This means you can SAVE SPACE because you install smaller size switches and panelboards.

Saving space often permits you to locate switches and panelboards in more convenient spots than would be possible if ordinary fuses or other protective devices were used

You also get some additional saving on fuse replacement costs because small size Fusetrons generally cost less than larger size fuses

On PRESENT installations

If you want to increase the size of a motor on a circuit—or add more motors—Fusetrons can often save you the cost of installing a larger switch or panelboard. Fusetrons hold starting currents, hence permit a great increase in the actual running load on the switch or panel.

Instead of tearing out your present switch or panel you just replace the ordinary fuses now in it with Fusetrons.

Often too, this saves the trouble and worry of looking for a spot to locate OVERSIZE equipment required by ordinary fuses or other protective devices.

Fusetrons give you a chance to *get full use* from every switch and panelboard in your plant

BUSS

Get Better Protection

With BUSS FUSETRONS

PROOF

Fusetrons saved money for a large Chemical Company in Michigan

Says the Vice President in charge of production, "several months ago we changed the motor on an induced-draft fan in our plant from 50 h. p. to 75 h. p..

A 200 ampere switch was already installed and there was really no place for a larger switch.

Our Electrical Engineer solved the problem by installing Fusetrons in the 200 ampere switch, thus saving the expense of buying a larger switch.

The old switch with the Fusetrons operates entirely satisfactorily—there has not been a single blow."

It may save you money and space to remember this experience the next time you must increase a motor load—or make a new motor installation.

WHAT IS THE FUSETRON?

The Fusetron is a DUAL element device—a Fuse to which is added a Thermal Cutout.

The result: a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have same degree of Underwriters' Laboratory approval for both motor-running and circuit protection as the most expensive devices made.

Fit standard fuse clips

Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.

They are obtainable in all sizes from 1/10 to 600 ampere in both 250 and 600 volt types. Also in tamper-resisting type (Fustats) for 125 volt circuits.

Their cost is surprising low

Get All the Facts

Get Better Protection—Send the Coupon Now

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons.

BUSSMANN MFG. CO., ST. LOUIS 7, MO.
Division McGraw Electric Co.

Get Many Kinds of Protection Heretofore Not Available by Installing Fusetrons Throughout the Electrical System

★ ***Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.***

Fusetrons have tremendous time-lag. They hold 500% load more than 10 seconds whereas most sizes of ordinary fuses blow in less than one second. They won't open on starting currents or harmless overloads (heavy overloads for a short time or light overloads for a longer time). Fusetrons won't shut down a circuit needlessly. They open only when something goes wrong.

★ ***Give Thermal Protection to Panelboards and Switches.***

The thermal cutout in the Fusetron will open whenever its temperature reaches 280° F. Thus if poor contact heat develops from any cause the Fusetron cuts off the current before damaging temperatures can be reached. Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

With Fusetrons you are warned that a minor maintenance job is needed instead of having panel or switch damaged or destroyed by poor contact.

★ ***Prevent needless blows caused by heating in panels and switches.***

Ordinary fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat and thus eliminate useless shutdown troubles caused by fuses running too hot in panelboards and switches.

★ ***Permit use of larger motor or adding more motors on circuit without installing larger switch or panel.***

See other page.

★ ***On new installations proper size switches and panels can be used instead of oversize.***

See other page

★ ***Protect motors against burnout.***

On normal installations, Fusetrons used in a size near ampere rating of motor will protect it against burnout from lack of oil, worn bearings, tight belt or anything that causes a dangerous electrical overload—yet their tremendous time-lag keeps them from blowing on motor-starting current.

★ ***Give double burnout protection to large motors.***

Larger motors already equipped with overload protection sometimes burn out due to thermals or relays failing to operate. Replace fuses used for short-circuit protection with Fusetrons of size near motor rating and they will protect motor against burnout from any electrical overload, entirely independent of other overload device.

★ ***Provide simplest way to stop burnouts from single phasing.***

When single phasing occurs, increased current flowing through remaining phase will open Fusetrons (if size used is near normal running current of motor) and shut down motor. Never before has such dependable single phasing protection been available.

★ ***Make burnout protection of small motors simple and inexpensive.***

Small motors have generally been operated without burnout protection because the cost of protecting them has been too great compared to cost of replacing motor. Now for the little cost of installing a Fusetron of proper size, any motor can be given safe, dependable burnout protection.

★ ***Protect coils, transformers and solenoids against burnout.***

Install a proper size Fusetron. It won't open on harmless overloads or normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

FUSETRONS

Sold Through Wholesalers

946

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

THE CABLE THAT S-T-R-E-T-C-H-E-S YOUR MAINTENANCE DOLLARS

THIS PERMANENTLY INSULATED ROCKBESTOS A.V.C. CONSTRUCTION GUARANTEES LONG-LIVED SERVICE

Rockbestos A.V.C. 600 Volt Power Cable above and similarly insulated Motor Lead Cable (Nat. Elec. Code Type AVA) have a maximum operating temperature of 110°C. (230°F.) and this failure-preventing construction:

- The conductor is perfectly and permanently centered in helically applied non-flowing heat, flame and moisture resistant insulation that provides greater current carrying capacity.
- An inner wall of impregnated felted asbestos that withstands conductor-heating overloads and won't bake brittle or burn.
- Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.
- An outer wall of heat, flame and moisture resistant impregnated felted asbestos that won't dry out, crack, flow, rot or burn.
- A tough age-resistant impregnated asbestos yarn braid that resists moisture, oil, grease and corrosive fumes as well as heat and flame.

One of 125 different constructions designed by Rockbestos for severe or unusual operating conditions. Voltage ratings up to 5000, sizes up to 2,000,000 CM.

Today, more than ever, it pays to install top quality heat resistant wire and cable in hot-spot circuits. High labor costs require it, tomorrow's high maintenance costs demand it; so when you rewire or install new power, lighting and control circuits . . . use *permanently insulated* Rockbestos A.V.C.

You'll get more out of these wires and cables because they have an *impregnated asbestos insulation* that takes operating temperatures as high as 230°F., *continuously* without failure. And because they also resist the destructive attack of corrosive fumes, oil, grease, moisture, and even flame, they last longer . . . give more dependable performance . . . and economically stretch your maintenance dollars by assuring continuous service at the lowest possible cost *year after year.*

Safeguard circuit operation in trouble zones and reduce maintenance with Rockbestos A.V.C. wires and cables. A wide range of types and sizes are available in 600 to 5000 volt ratings. Write for a catalog describing Rockbestos-designed National Electrical Code types and many others.

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ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK · BUFFALO · CLEVELAND · CHICAGO
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Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

WORLD'S LARGEST COAL MINE HAS WATER FRONT TIPPLE AT ROBENA

▲ The world's largest coal mine is open for business at its own water front tipple, H. C. Frick Coke Company, coal-producing subsidiary of United States Steel.

The new dock at Robena mine, located 80 miles south of Pittsburgh, will feed thousands of tons of fresh bituminous coal daily into barges destined for steel plants down the Monongahela River.

Eventually Robena is scheduled to ship 20,000 tons of coal a day. That is enough in one day to heat 2,000 average homes for an entire winter. Mines producing 5,000 to 10,000 tons a day are normally considered big.

Named for the mother of Harry Moses, president of Frick, and the wife of Thomas Moses, former Frick president and retired vice president of United States Steel Corporation of Delaware, Robena mine is not only the world's biggest mine, but one of the most modern. Completely mechanized, it differs greatly from the coal mines of yesterday. Much of the miner's daily job approximates the push-button operation of assembly lines in modern manufacturing plants. Track-mounted drilling, cutting and loading machines do most of the work.

A large number of the main underground passageways in Robena are built with steel beam overhead construction similar to New York's famed subways.

The entire output at the mine mouth is handled by an intricate system of heavy rubber conveyor belts, some as much as six feet wide. Coal is transported from the working "face" in modern steel cars, pulled by electric locomotives. The mine has two rotary dumps into which the coal is fed at the base of a 300-foot slope leading to the outside. Each rotary can handle 10 car loads at a time. In them, high and low sulphur coals are blended in the first of several steps taken to insure uniformity in chemistry of coal for producing metallurgical coke.

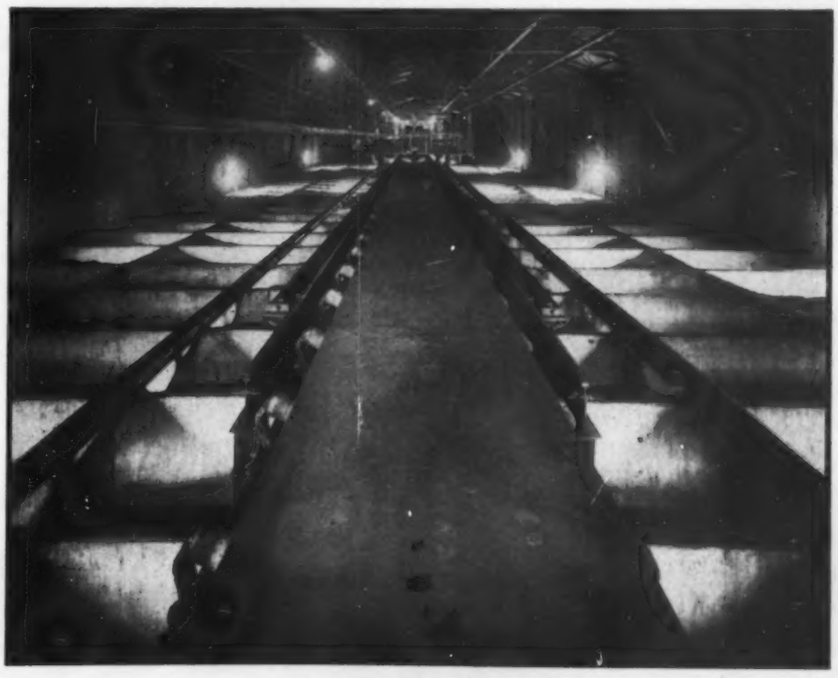
The rotaries empty their loads onto a five-foot belt which conveys the product to the surface, thence to the top of a tall building housing shaker screens, picking tables, and crushers. Here, slate and other coarse refuse are removed and the coal is crushed to size minus three, that is, three inches or smaller.

A small, automatic sampler takes off test samples periodically.

Then the coal is delivered by another belt system to the top of an 18,000-ton blending building, where a shuttle belt assembly distributes it into deep, concrete blending bins. At present, the coal is moved from the bottom of these bins to the top of the river tipple into loading bins from which chutes empty it into river barges. The tipple has seven chutes. With all working, they can fill a barge with 900 tons of coal in about six minutes.

Coal barged from Robena tipple to the Clairton by-product coke ovens of Carnegie-Illinois Steel Corporation,

The entire output at the mine mouth is handled by an intricate system of heavy rubber conveyor belts.



where coke is produced for the Pittsburgh district mills of Carnegie-Illinois, National Tube Company, and American Steel and Wire Company, all U. S. Steel subsidiaries.

Until the opening of Robena's own modern dock-loading facilities, coal from this mine has been transported under the Monongahela to docks at Ronco, Pennsylvania, for barge loading.

Under construction, close to the Robena dock, is a new coal cleaning plant. When it is completed, the mine product will go there before entering the barges. In the cleaning plant, the raw coal, as mined, will benefit by processes relatively new to the coal industry. At present, Robena coal is cleaned at Clairton.

The mine has a water-treating plant with a capacity of one million gallons a day, for mining and coal washing requirements, and other water needs.

Robena is situated in a 69,000-acre Greene County coal reserve in the Pittsburgh seam, near Carmichaels, Pennsylvania. Long planned, the mine was first opened for development purposes in 1937. The war made heavy demands on the Frick coal reserves in Fayette County, making it necessary to speed plans for full development of the Greene County workings.

TCI INITIATES 2-YEAR CONSTRUCTION PROGRAM

▲ An extensive new construction program at the Fairfield Sheet Mill of Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama, requiring approximately two years for completion, was announced today by Robert Gregg, president of this U. S. Steel subsidiary.

The main objective of the program is to modernize and improve the facilities at Birmingham for the production of sheets through a conversion from the Tennessee company's present hot-rolled method to the cold-reduced method of producing sheets. Another major improvement will be the installation of equipment for the production of galvanized sheet metal in coils, thus making Fairfield one of the few sheet mills in the country capable of providing such material.

Included in this modernization program are the installation of a 54-inch, 4-high, four-stand, cold reduction mill; 48-inch continuous pickling and cleaning lines; two continuous galvanizing lines, one handling material in widths ranging from 20 to 30 inches and the other in widths of 20 to 48 inches; and annealing and shearing facilities of the latest design.

WESTINGHOUSE DEVELOPS IMPROVED MOTOR DESIGN

▲ Major improvements in design and construction of the widely used induction motor, pioneered 58 years ago by Nicola Tesla, should not logically be expected. Usually after such a time any device reaches a stage in its evolution where changes relate only to detail.

However, this year a new alternating-current motor makes its appearance which represents a sudden advance above the normal rate of progress. This motor, known as the Life-Line, is more than 35 per cent smaller in size than its predecessor. The reduced size has been accomplished without sacrifice of electrical properties. Starting torques have been increased as much as 134 per cent per lb of motor and maximum torques increased as much as 116 per cent per lb of motor. High efficiencies and power factors are maintained. The appearance is certainly much improved and, perhaps even more important these days, maintenance requirements are materially decreased. Specifically the bearings will need no attention for at least five years. Shock resistance is increased manyfold. Vibration and noise have been reduced to new low limits. Fewer insulation burn-outs will be experienced because of new features in insulating materials and improved winding techniques. In short, this newest squirrel-cage motor takes its place with four or five other peaks of progress in motor history.

Intensive engineering development and research, based on years of experience, have been applied to the use of new materials, new methods, new processes, and new tools in developing this motor. Even a large new factory in a new location has been purchased for its production. Everything possible has been done to create a truly new motor.

The use of steel instead of the more conventional cast iron makes this motor stronger. Its use is not entirely new; however, in this motor the novelty is that the structural steel sections are as thick as they would be if made from cast iron. Normal inclinations are to use thinner sections of steel than cast iron, and frequently steel motors have been justly classed as sheet-steel motors.

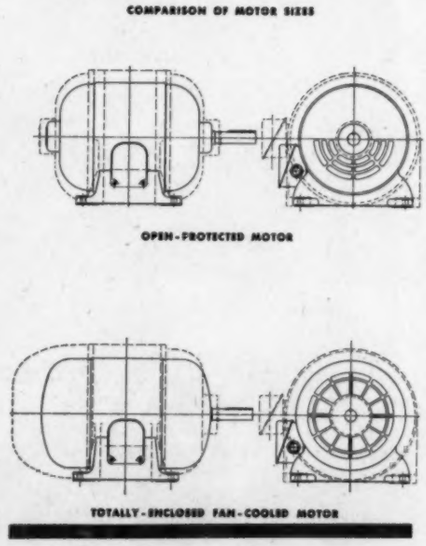
Shock resistance of steel is much greater than cast iron as became evident during the War when use of cast iron on Naval vessels became taboo because of its low shock resistance. Steel motors had to be developed and much experience was obtained in their use. Thus the War experience is reflected in a peacetime motor of marked increase in shock resistance and ruggedness.

It is a fallacy that steel corrodes faster than cast iron. Research tests demonstrate the two materials to corrode at equal rates. The explanation for the common belief lies in the fact that when cast iron is replaced by steel, the steel is usually of thinner section and will rust through sooner. Where thick steel sections are used, excessively rapid corrosion is not experienced.

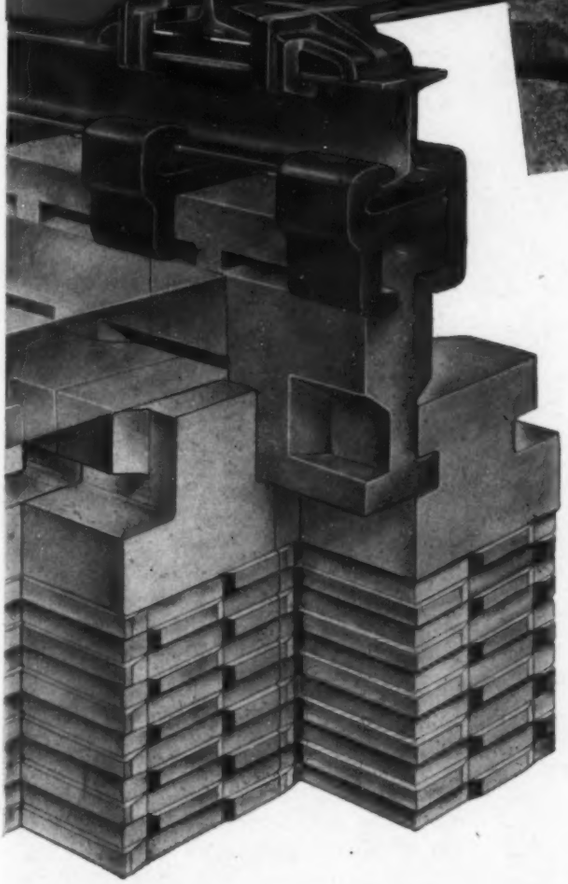
The finish coating will consist of base coats of baked thermoset varnish with a final coat of lacquer. Tests and experience have demonstrated that steel with this finish is adequately corrosion resistant for general application. In some extremely severe applications, such as in chemical

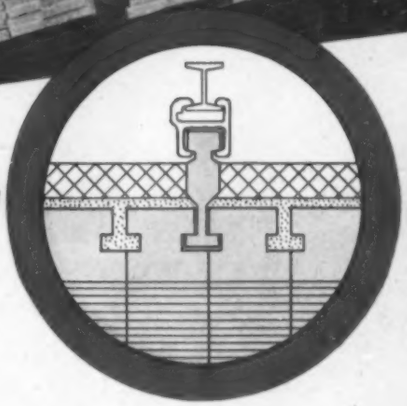
(*Please turn to page 110*)

Figure 1 — Comparative sizes of 7½-hp motors. The new motor, inside solid lines, is contrasted to last year's models shown by outside dotted line.



Proved by 4 Years of Operation... Over 100 INSTALLATIONS!





DETRICK REFRACTORY HANGER ROOF

provides longer roof life

lower maintenance . . . better

furnace operation

IN OVER a hundred installations the outstanding performance of this remarkable construction has proved the soundness of the engineering involved. It has been applied on In and Out furnaces, Continuous Heating furnaces, Open Hearth Checker Chambers, Skelp furnaces, Annealing furnaces, and many special process furnaces.

Note how the ingenious design of the hanger tile permits it to support four Detred face tile, each of which is intermeshed with the other, thus forming an interdependent mass. An insulating cement is grouted over the tile which positively seals against air leakage, and Block insulation is added to reduce heat loss.

The result is a furnace roof with longer refractory life . . . less air and gas leakage, and one that can take more insulation.

Send for details of this construction and list your name for a new brochure on steel furnaces, now in preparation.

M. H. DETRICK COMPANY, 111 West Washington Street, Chicago 2, Ill.

DETRICK FURNACE ENCLOSURES

USE DETRICK INSULATION . . . *PLASTIC or BLOCK*

plants, stainless steel will be used for shields and hoods.

Improved appearance in surface smoothness is made possible by use of steel instead of cast iron. Much attention has been given to the contour of this motor, for applications such as machine tools, where the motors are in the open. Regular external shape and smooth surface contribute to its good appearance. The final contour is the result of the efforts of expert artistic designers.

The use of steel has resulted in a smaller size. In motors, minimum clearances must be maintained between windings and grounded parts of the frame. Since dimensions of formed steel parts can be held more accurately than those in iron castings, allowances for large variation in cast iron do not have to be made. This may amount to a saving of one-quarter inch on a 10 inch diameter or length.

Size is also reduced by an improved engineered cooling system. Losses in a motor are inherent and are dissipated in the form of heat. Temperature rise beyond a certain point is not allowable because of detrimental effects on electrical insulation and the heat must be carried away from the motor. Most of it is transferred to air blown over the hot surfaces. Much more air passes through this motor than through its predecessor, thus permitting the reduction in size of the cooling surfaces while adequately maintaining temperature limits.

Comparative motor sizes of 7½-horsepower ratings are shown in Figure 1. The open-protected machine is 83 per cent as large in diameter and 94 per cent as long or a saving of 35 per cent of the volume of last year's machines. The new totally-enclosed motor is 83 per cent as large in diameter and 82 per cent as long, saving 44 per cent of the volume of its predecessor. (Standardized NEMA dimensions have been maintained). These drastic reductions in size have been accompanied by improvements in electrical and mechanical performance. Size reduction has resulted largely from elimination of superfluous cast iron. Sizes of electrical working parts have remained substantially the same.

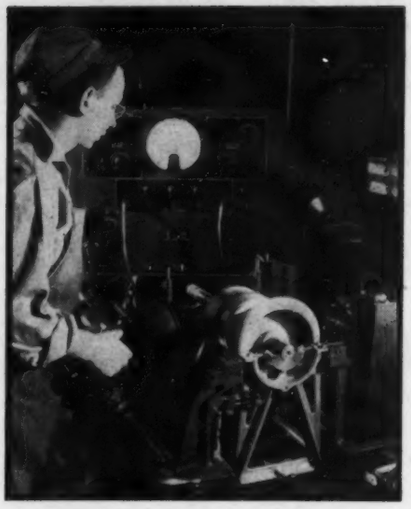


Figure 2 — Cast rotor and blower for this new motor being dynetrically balanced at the Buffalo plant of Westinghouse.

Smooth, quiet operation has been accomplished by careful engineering and thorough precision manufacture. Noise and vibration are produced by harmonic forces acting on parts which distort in response to them. Proper choice of slot combinations and of winding distribution have eliminated and reduced disturbing electrical harmonics.

Precision manufacturing and quality control give concentric air gaps which reduce the distortion due to remaining harmonic forces. Bracket-bearing bores and frame fits are machined in one set-up on a multiple-head machine. Bearing fits are later qualified and are checked with a precision air gauge. Frame fits are concentrically machined relative to the punching bores in a double-end lathe.

Mechanical harmonic forces produced by unbalance, are eliminated by dynamic balancing in a dynetric balancing machine, Figure 2. Such balancing is not new on motors. But further improvement in mechanical balance is obtained in these motors through straighter shafts and improved bearing concentricity.

Reliable bearings are an important

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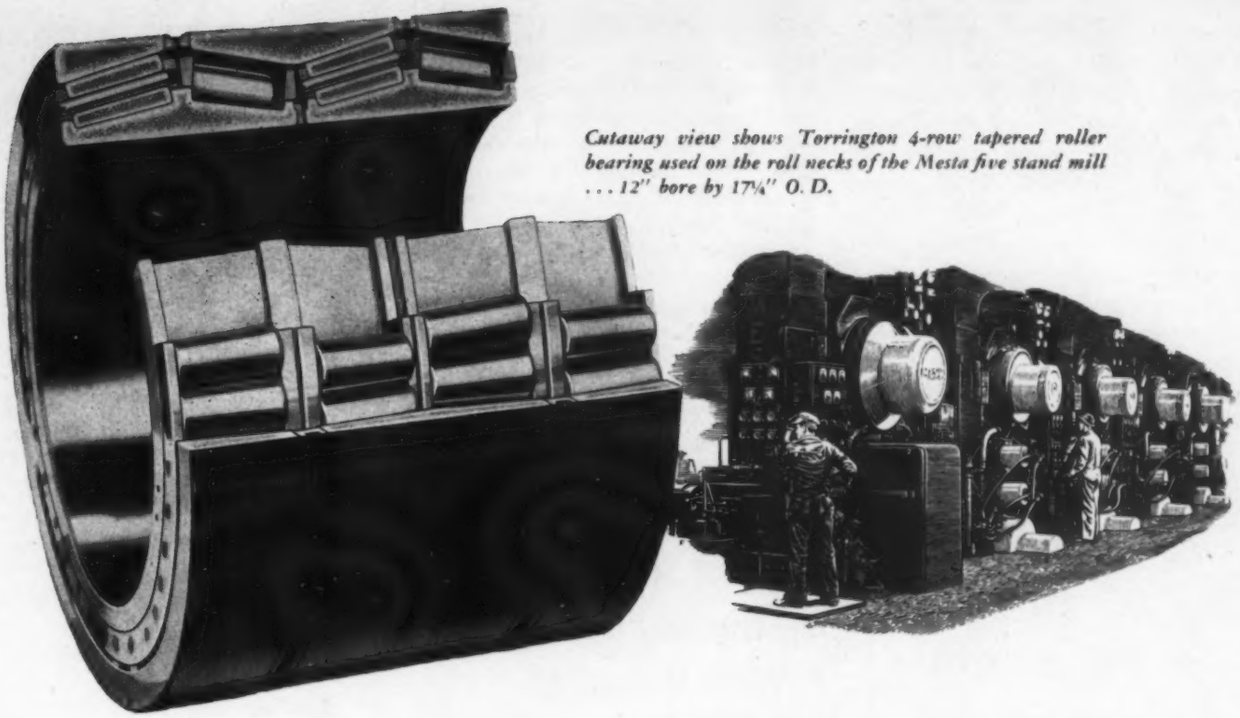


Cutaway view shows Torrington 4-row tapered roller bearing used on the roll necks of the Mesta five stand mill . . . 12" bore by 17¼" O. D.

FOR ROLL NECK APPLICATIONS

. . . and other heavy-duty jobs

The mill you see above delivers 3200 feet of cold strip per minute. That means high R.P.M. on the roll necks . . . speeds and heavy loads handled efficiently by Torrington 4-row tapered roller bearings. Made of S.A.E.-3310 steel (with higher nickel content) for maximum service life, the bearings have the additional advantage of a simple design.

On reels, screwdowns and edgers . . . on work rolls, back-up rolls, shears and drives . . . on table rolls, pinion stands and other steel mill equipment . . . bearings designed and built by Torrington's Bantam Bearings Division are also meeting today's anti-friction requirements.

In these competitive days, you should be "backed up" with that kind of performance from *your* steel mill equipment. For maximum roll neck diameters, bearings of all tapered types can be supplied with proportioned cross-section. And our engineers will gladly help yours to incorporate Torrington Bearing advantages in your designs.

THE TORRINGTON COMPANY • BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

THE TORRINGTON SELF-ALIGNING SPHERICAL ROLLER BEARING

features self-alignment, two-directional thrust and unit construction for easy installation and handling. It will be manufactured in a complete range of sizes from 1.5748" bore and up. See your nearest Torrington representative or write for Bulletin 200.

TORRINGTON BEARINGS

SPHERICAL ROLLER • STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

asset as, without proper consideration, they can be the most troublesome feature of a motor. Completely proven prelubricated ball bearings, pioneered by Westinghouse, are used throughout the line. They require lubrication no sooner than five years after the motor is placed in operation. During the last nine years, large numbers of prelubricated motors have operated free of trouble under severe conditions. It is felt that five years without relubrication is conservative. Originally the bearings are expertly greased in the factory with high-quality, long-life material. Relubrication with comparable methods and grease will prolong the life of the motor. Much damage can be done by adding dirty grease frequently. Such haphazard greasing is avoided as the bearings have to be disassembled to be maintained. The sealed bearings withstand extreme dirt tests where motors are tested in dust boxes.

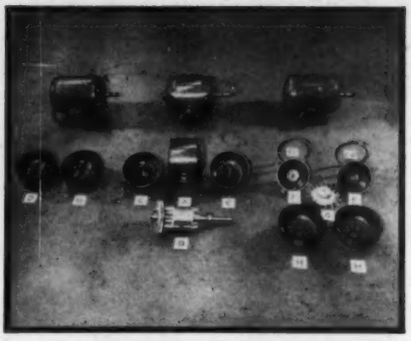


Figure 3 — The basic subassemblies and parts for the three different motors now being produced at the Buffalo plant of Westinghouse illustrate the interchangeability that has been designed into this motor.

Most failures are traced to damage of insulation during the winding process or to faulty and inadequate insulation. To simplify and facilitate the winding process, slot shapes and sizes, coil shapes and sizes, and connections were all redesigned. The slot openings were enlarged. The result is that winding is much easier and there is less handling and bending of the coils with a consequent reduction of damage.

Figure 3 shows three popular types with their component parts. Left to right are splash proof, open-protected, and totally-enclosed fan-cooled. The open protected consists of stator, A, brackets, C, and rotor assembly, B. To make it splash proof the brackets, C, are oriented with their openings facing upward and the hoods, D, placed over the ends. Space between the hoods and the brackets allows air to enter and leave.

To make a totally-enclosed fan-cooled motor the frame, A, and the rotor, B, without fan are used with brackets, F, spacers, E-1 and E-2, blower G, and hoods H. The brackets seal the inside and support the bearings. Air, pulled in through a hood, is directed between the frame ring and the stator iron, and exhausted out of the other hood.

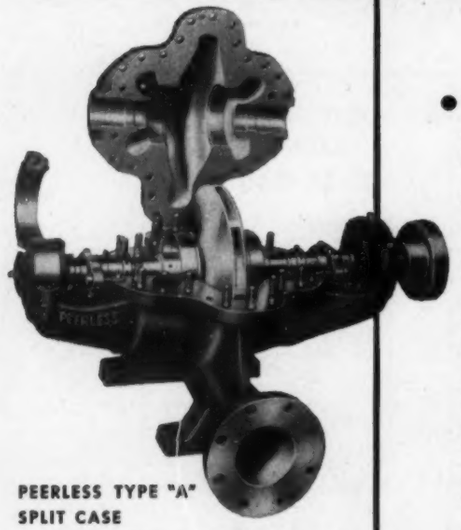
Conduit box may be reversed by reversal of the frames on each of these three types.

Probably for the first time in the industry has a company had the unusual opportunity of designing a completely new motor and planning its manufacture in a new factory designed for large scale production.

—E-75—

PEERLESS
FORMERLY DAYTON-DOWD
Horizontal Centrifugal PUMPS

General Service Continuous Duty A Wide Range of Sizes and Capacities Up to 60,000 G.P.M.



PEERLESS TYPE "A" SPLIT CASE
Capacities: up to 60,000 g.p.m.
Single Stage—Double Suction.
Embodies most advanced hydraulic design and efficiencies.
Ball Bearing Type.

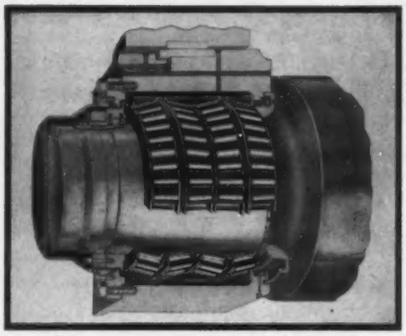
- Effectively used in all types of industries where high-grade pumping is needed under stress of pressures and high temperatures. Peerless Centrifugal pumps can be furnished in other than standard specification metals and dimensions for special pumping problems.

Learn of the many advantages gained when you pump with a Peerless. Write Today.

PEERLESS PUMP

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
Canton 6, Ohio
Quincy, Illinois
Los Angeles 31, California
DISTRIBUTORS IN ALL PRINCIPAL CITIES

BEARING DESIGN INCREASES LIFE EXPECTANCY BY 300%



The Timken bearing whose design is shown above, because of its principle of "balanced proportions," is expected to increase bearing life in bar mills by three hundred per cent. Average bearing tonnage on an 18 in. mill which has been in service since 1931, using a 10¼ x 16⅝ x 12½ bearing with a rating of 500 rpm of 112,760 lb, is better than 2,000,000 net tons.

Because it allows larger and stronger roll neck to be used, application of the new Timken bearing results in 68 per cent greater roll neck strength in addition to the greatly increased life expectancy. New mills of this size will be equipped with 11⅝ x 16⅝ x 12¼ Timken bearings with a rating at 500 rpm of 153,020 lb.

—E-76—

WIRE FIRM NOW MAKING STEEL RODS FOR SPRINGS

▲ A triumph in the art of manufacturing quality steel wire has been achieved by the American Steel and Wire Company, U. S. Steel subsidiary in producing great amounts of valve spring wire so vital to the efficient operation of America's post-war automobiles.

Prior to the outbreak of World War II, virtually all of the steel rods for reduction into wire for automotive valve springs were imported from Sweden. In that country, extremely high grade ores were readily available. Swedish iron plants, for the most part, were small units utilizing charcoal rather than coke for fuel, resulting in a cleaner iron and a cleaner steel. Rolling mills were small, hand operated units which, while producing comparatively small tonnages, permitted extreme care to be exercised in producing steel rods with virtually no seams or scratches. Extremely high surface qualities are of great importance when attempting to avoid failure of the material used in springs

HANDLING PROBLEMS DESERVE *Special* ATTENTION

EVERY manufacturer, in striving to keep costs at a minimum, must deal with more or less difficult material handling problems. These are not always quickly solved, and usually require considerable thought by plant and conveyer engineers. Most experienced plant engineers agree that the use of Mathews methods and Mathews equipment means efficient material handling. That is why Mathews Engineers are usually called in on the problem requiring special attention. There are many types of Mathews Conveyers of both gravity and power designs, and from these types are selected the units which make up Mathews continuous flow conveyer systems. It is with such systems that prominent manufacturers are reducing worker fatigue and keeping materials moving through processing machinery, storage and shipping, with a minimum of product re-handling, costly confusion and delay.

It might be that a Mathews Engineer can show you what others in your industry have done to improve their material handling. We will welcome your inquiry and give it prompt and thorough service.

MATHEWS CONVEYER COMPANY
ELLWOOD CITY, PENNSYLVANIA
SAN FRANCISCO, CAL. • PORT HOPE, ONT.
ENGINEERING OFFICES IN PRINCIPAL CITIES

MEDART MULTICYCLE

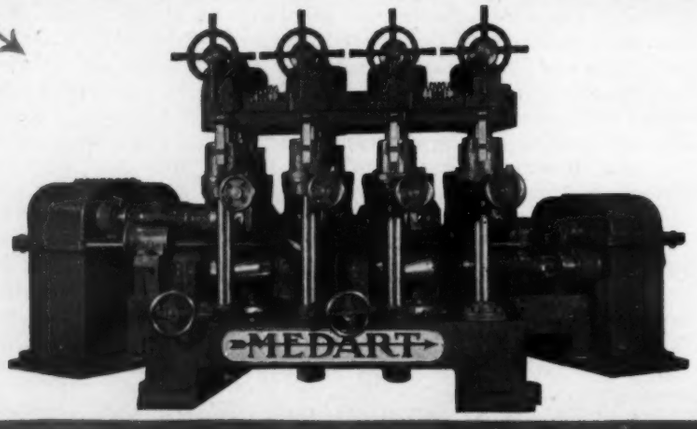
PIPE AND TUBE STRAIGHTENING MACHINE

"6 in 1"

SIX POINTS OF SUPERIORITY IN ONE

1. MULTICYCLE STRAIGHTENING—Two bending rolls impose duplex straightening cycles on workpiece insuring end to end straightness.
2. POSITIVE AND SYNCHRONIZED FEED—All four feed rolls are driven insuring positive synchronized feed and torque balanced around neutral axis of workpiece.
3. THE WORKPIECE LEVEL—Maintains one feeding level for all sizes of pipes or tubes—eliminates need of adjustable entry and delivery tables.
4. NO GUIDES—Horizontal position of the six rolls with balanced torque eliminates requirement for guides.
5. SINGLE MOTOR—All four driven rolls powered from a single motor, for synchronization and economy.
6. NO BEVEL GEARS—All gears enclosed in cases and running in oil, for sure trouble free operation.

"Patents make Jobs"



MANUFACTURING ENGINEERS OF COMPLETE TRANSMISSION EQUIPMENT AND SPECIALIZED MACHINERY

MEDART

THE MEDART COMPANY — 3600 DE KALB ST. ST. LOUIS, MO.

which are compressed and released 4,000 times each minute.

With the advent of the war in 1939 shipments from Sweden were cut off and metallurgists of the American steel industry, including American Steel and Wire, were faced with the problem of replacing that source of high grade steel rods. The result was that a product superior even to the Swedish material was developed for use in the last of the pre-war automobiles. It played an important wartime role in keeping in operation the jeeps, peeps, half-tracks, tanks, and other mobile equipment so vital to the winning of the war.

Extreme care is exercised in choosing raw materials for this premium steel product. Only carefully graded pig iron and steel scrap are used, and improved steel-making practices have been developed. Special heat-treating methods, together with close rolling and drawing controls, also contribute toward producing a high quality steel wire free from surface imperfections and possessing other physical properties rendering it more than adequate to make American automobile manufacturers independent of the foreign source of supply.

LUBRICANT MANUFACTURER ANNOUNCES 3 NEW OILS

▲ Announcement of three additions to the well known Regal oils (R&O), which are designed for turbines, hydraulic and circulating systems, is made by the Texas Company.

The new lubricants are classified as Regal oils (R&O) AZ, F, and G. Regal oil (R&O) AZ is suitable for use in hydraulic equipment in subzero temperatures, and F and G are developed for use in mills where rust and oxidation inhibited oils of corresponding viscosity are needed.

The oils (R&O) are rust and oxidation inhibited oils which prevent clogging of oil lines, scoring of journals, and sticking of governors in marine and stationary turbine installations as well as rusting and sludging in hydraulic and circulating systems at both idle and operating temperatures.

Incorporation of certain chemical additives having no undesirable effect

(*Please turn to page 123*)

Pouring an "M.C." ROLL

UNITED... *Announces* the NEW* "M.C." ROLL

(Identified by Dark Blue Wabbler)

One of the most difficult to obtain and yet highly desired specifications demanded of a maker is to produce a roll with sufficient wear resistant depth for deep section rolling, and for finishing and semi-finishing work on bar mills and rod mills.

UNITED has satisfied this demand by the development of the "M.C." Roll, a truly *Master Chilled* Roll with a chill that *shows no mottle* at any reasonable working depth. Combined with the desired feature of depth, "M.C." Rolls, through special alloying and a carefully controlled melting practice, give the user added assurance of strength and long service life.

"M.C." Rolls are made in one grade only. The hardness range is from 60 to 65, and *this hardness structure is maintained through the entire working depth.*

"M.C." Rolls are a proven product—an answer to the demand for rolls with deep chilled structure and strength, especially in the small and medium diameter range.

Specific recommendations for their application will be gladly furnished at your request.

UNITED ENGINEERING AND FOUNDRY COMPANY

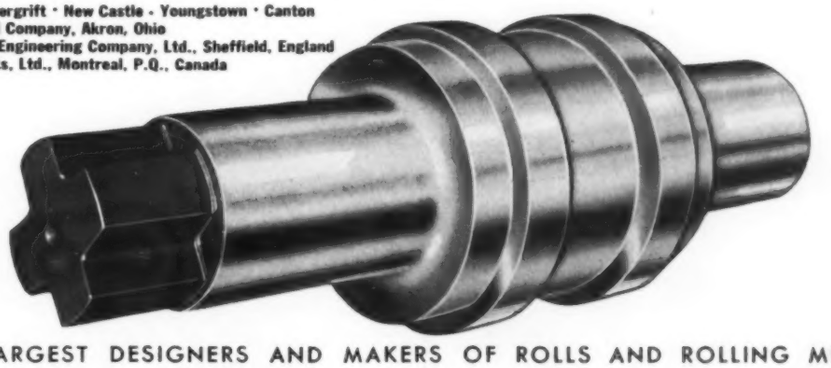
Pittsburgh, Pennsylvania

Plants at Pittsburgh · Vandergrift · New Castle · Youngstown · Canton
Subsidiary: Adamson United Company, Akron, Ohio
Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P.Q., Canada

* One of A Complete Line of 16 UNITED ROLLS Individually Color-Branded for Type Designation

The 16 principal classifications comprising the UNITED ROLL LINE . . . each one a roll type successfully used in modern industry . . . are individually and distinctively *color-branded* to designate *type, composition* and *service application.* Roll selection is thereby made easy and accurate.

UNITED ROLLS are the product of advanced metallurgical research and more than 40 years experience in roll design and manufacture.



*THE WORLD'S LARGEST DESIGNERS AND MAKERS OF ROLLS AND ROLLING MILL EQUIPMENT

WALTER NIELSEN
BIRMINGHAM DISTRICT SECTION

R. W. GRAHAM
BUFFALO DISTRICT SECTION

W. J. TUNNEY
CHICAGO DISTRICT SECTION

THE ASSOCIATION OF IRON AND STEEL ENGINEERS

District Chairmen 1946-1947

Walter Nielsen was born in Wisconsin, and graduated from University of Michigan in 1932. He was employed by Sloss Sheffield Steel and Iron Company, Birmingham, Alabama from 1933 to 1937 as burden clerk, stockhouse foreman and yardmaster. He then went to Woodward Iron Company as utility engineer. He next spent three years as a management engineer in Birmingham for Neville, Brown & Walters, doing cost reduction and consulting work. In 1940, he returned to Sloss Company as practice man, and was made superintendent of North Birmingham furnace plant in 1941.

R. W. Graham has been employed in the steel industry since 1916, except for 18 months spent in naval service in World War I, as radio and communication officer on U.S.S. Arizona. Starting with Lackawanna Steel Company as assistant electrical engineer, he remained in that capacity until the Lackawanna plant was absorbed by Bethlehem Steel Company in 1923. He then worked as assistant superintendent of the electrical department until April 1943, when he was made electrical superintendent. He is a graduate of North Dakota and Cornell Universities and taught in Cornell Engineering College for three years.

William J. Tunney was born in Chicago, Illinois where he received his grammar and high school education. He obtained his electrical engineering training at Armour Institute of Technology in Chicago, now known as Illinois Institute of Technology. He then joined the engineering department of the Youngstown Sheet and Tube Company, East Chicago, Indiana, where he subsequently progressed as Electrical testing engineer, chief of the electrical testing department, and in 1943 was promoted to his present position of assistant electrical engineer.

Frank E. Robinson was born in Lima, Ohio and a few years later moved to Birmingham, Alabama, where he attended public schools and technical high school. During the first world war he was employed by Tennessee Coal, Iron & Railroad Company as a draftsman on the construction of the first units of Fairfield works. In 1920 he came to Cleveland with Otis Steel Company as chief draftsman in the blast furnace division, and completed a night school course in mechanical engineering at John Huntington Polytechnic Institute. In 1925 he began working for American Steel & Wire Company as designer-checker, later being advanced to section head draftsman, assistant construction engineer and in 1945 to a newly created position of division engineer of projects.

J. Arthur Shimmin was born in Monmouth, Illinois, where he received his early education and also attended Monmouth College. After three years with the Delco Light Company in Illinois, he worked as electrician for the Continental Motors in Muskegon, Michigan. In 1923, he entered the service of the Detroit Edison Company, where he remained in various capacities until 1942. During this period Mr. Shimmin attended Wayne University, from whence he received a bachelor of science degree in 1939. He joined the Rotary Electric Steel Company in 1942 as superintendent of maintenance, and is now plant engineer in charge of engineering, mechanical and electrical maintenance, and construction.

C. R. Hand, assistant superintendent of the mechanical department at Bethlehem Steel Company, Sparrows Point, Maryland, was born at Baltimore, Maryland, and attended public schools, high schools and night school in Baltimore and Sparrows Point. He began work in the steel plant at Sparrows Point in 1911 as an open hearth helper and worked in various departments including ore mines, coke ovens, blast furnaces, shipyard, metallurgical and mechanical departments. He was made lubrication engineer in 1928, and was appointed to his present position in 1946.

E. L. Anderson has been associated with the iron and steel industry for the past 29 years, having started in the electrical department of the Bethlehem Steel Company at Sparrows Point, Maryland, in 1917. He was transferred to the Johnstown plant of Bethlehem in 1937, and was appointed superintendent of the electrical department of that plant in 1940.

FRANK E. ROBINSON
CLEVELAND DISTRICT SECTION

J. A. SHIMMIN
DETROIT DISTRICT SECTION

C. R. HAND
PHILADELPHIA DISTRICT SECTION

E. L. ANDERSON
PITTSBURGH DISTRICT SECTIO

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

WARE HI-LAG *Renewable* FUSES

The Fuse That Science Built Cool to Prevent Excessive Heating During Heavy Current Loads and Long Service

When you make that next fuse installation, consider the World's Best and Coolest Operating Fuse—try WARE HI-LAG.

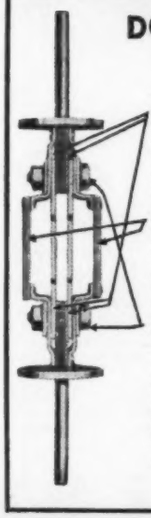
You will then see for yourself how the WARE HI-LAG stays cool under conditions that ordinarily cause overheating—you will see why it's good business to standardize on a product that ends costly delays—needless production shut downs and interruptions.

There's higher lag for motor starting overloads—stronger lag for operating current surges—lower contact resistance, reduced heating and larger and stronger terminal connections.

The double-bridge assembly at left is another cool construction feature, helping to lower contact resistance and excessive heating.

Write for Brochure giving details of all the COOL FACTS, sizes and prices.

Cool Facts No. 2



DOUBLE BRIDGE ASSEMBLY

Spring tension, double contact area on link.

Links centered in all casings.

Double Fibre Bridge for Alignment and Strength.

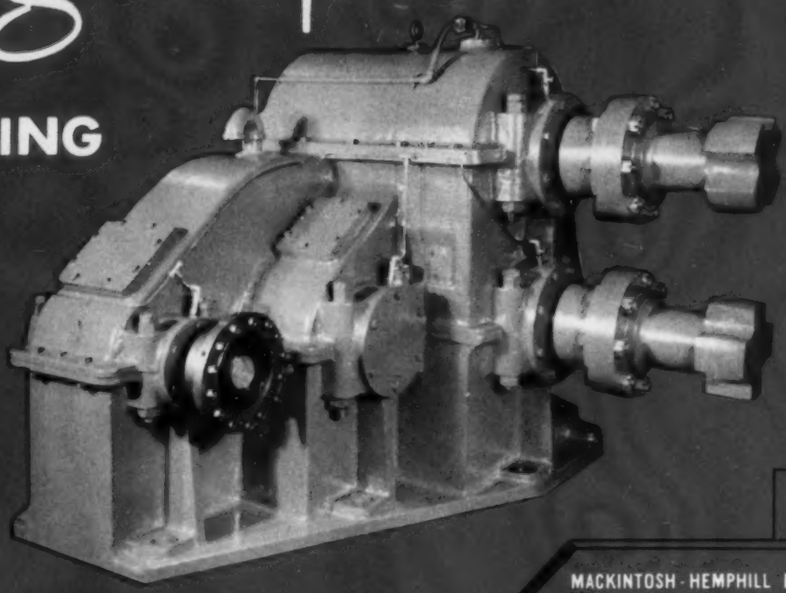
Screws Locked—Only one wrench needed.

Insert either end in Casing. Minimum of parts.

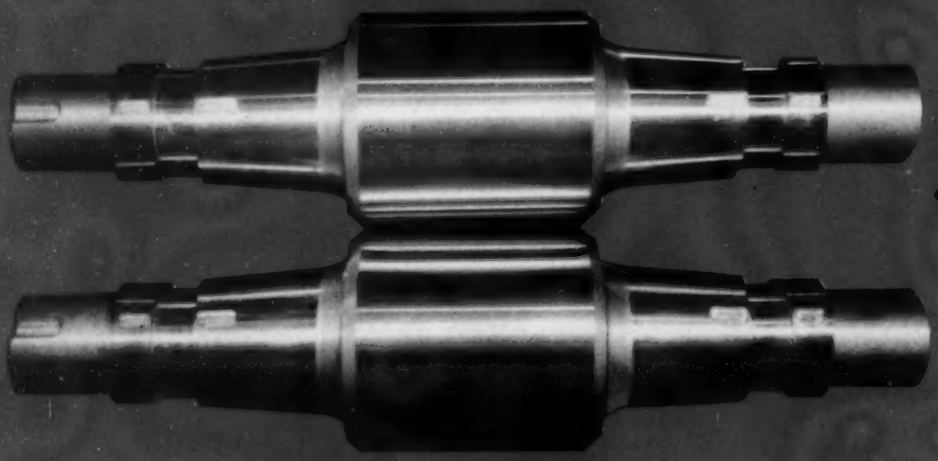
APPROVED BY UNDERWRITERS' LABORATORIES

WARE Brothers 4450 W. LAKE ST.·· CHICAGO 24, ILL.

8 guideposts to PRODUCTIONEERING



MACKINTOSH-HEMPHILL DRIVES transmit power for industry's metal rolling mills.

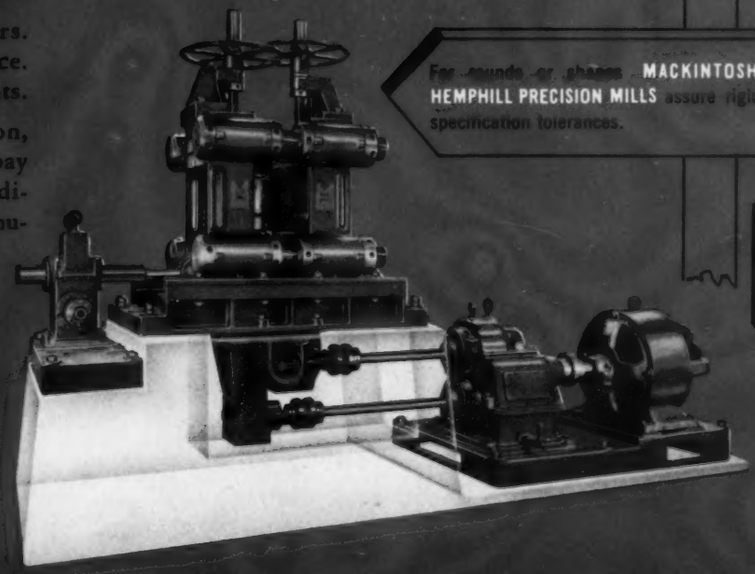


ROLLS WITH THE RED WABBLERS will make short work of your production rolling operations.

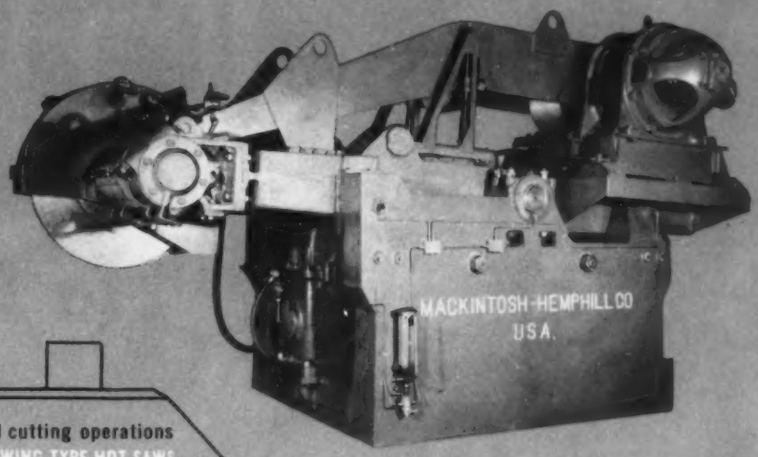
MACKINTOSH-HEMPHILL facilities for the design and construction of heavy industrial machinery include:

- A competent staff of experienced engineers.
- Metallurgists trained in metal mill practice.
- Two completely manned manufacturing plants.

In the present-day struggle with competition, higher costs, and lost productive time it will pay to keep your eye on what's new in the widely diversified types of production machinery manufactured by MACKINTOSH-HEMPHILL.

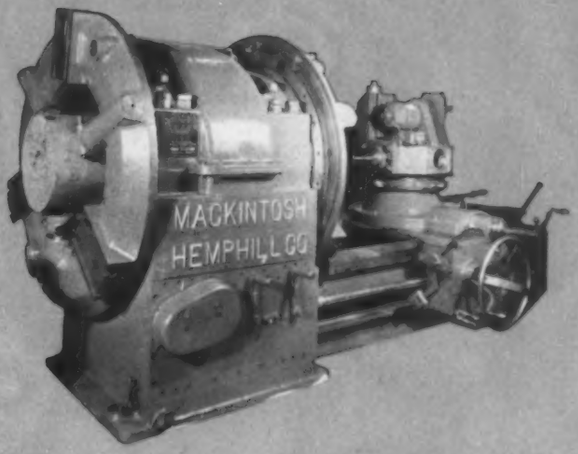


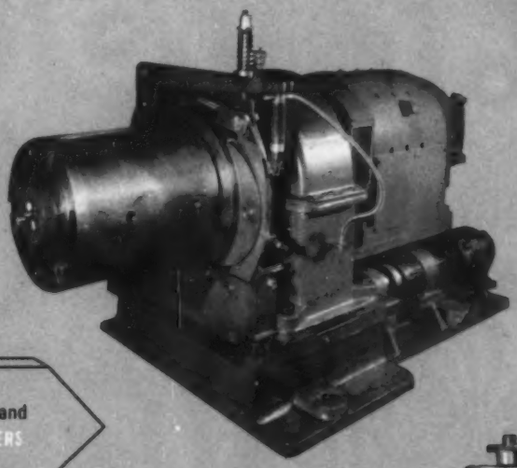
For rounds or shapes MACKINTOSH HEMPHILL PRECISION MILLS assure rigid specification tolerances.



For high-speed cutting operations there are M-H SWING TYPE HOT SAWS and many types of shears.

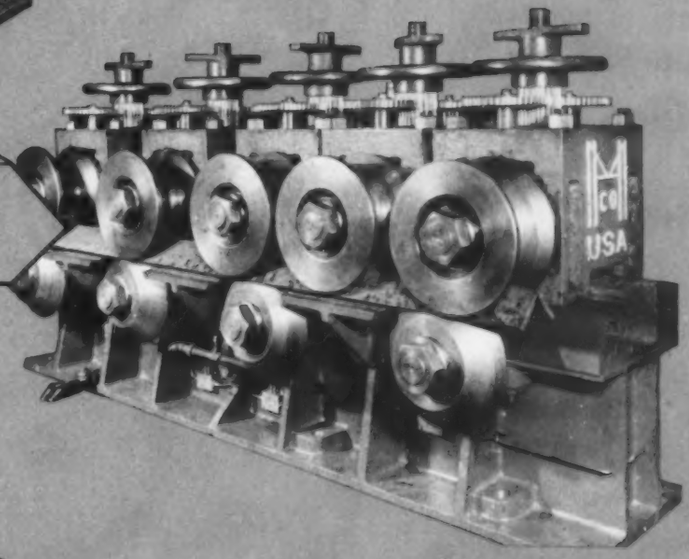
M-H HOLLOW-SPINDLE TURRET LATHES, together with heavy-duty lathes of many types, fulfill many special productioneering requirements.



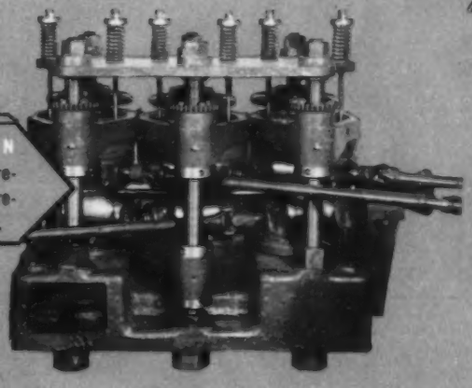


For all types of metals, in all widths and coil weights, there are M-H STRIP COILERS.

There are M-H ANGLE AND SHAPE STRAIGHTENERS, too, in the M-H catalog of metal straightening equipment.



MACKINTOSH-ABRAMSEN STRAIGHTENERS leave no score-marks on finished products, require minimum setting-up time.



MACKINTOSH-HEMPHILL CO.

PITTSBURGH · MIDLAND, PA.

Makers of the rolls with the red wabblers

Wapakoneta SHEAR BLADES and SLITTERS ...

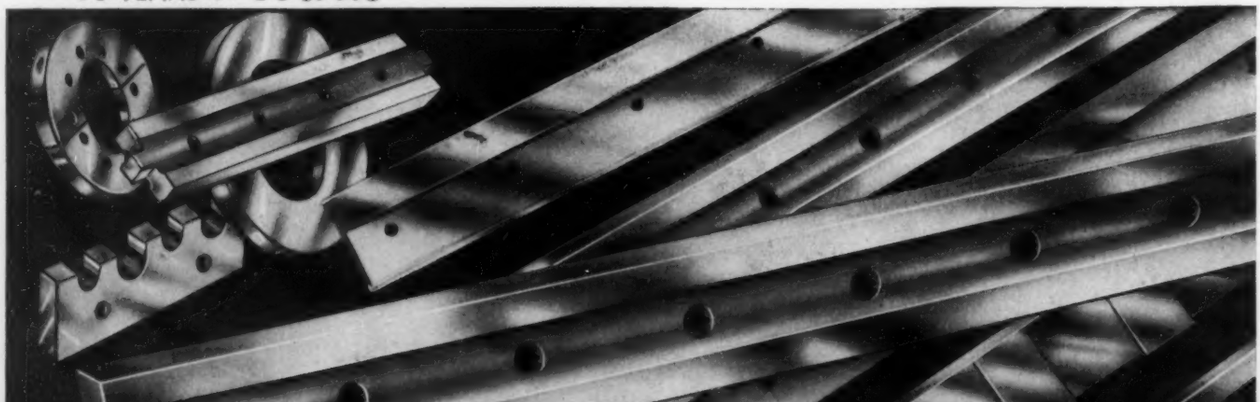
ENGINEERED FOR THE JOB

MORE THAN 50 YEARS of Service

THEY HOLD THE EDGE

because they are tempered and ground for your particular needs

Wapakoneta Shear Blades are made and heat treated, ***not*** to meet some universal standard of our own, but to best fill each customer's requirements... That is why Wapakoneta Shear Blades stand up longer on the job and cut more tonnage.



The Wapakoneta Machine Company

INCORPORATED 1891 — Wapakoneta, Ohio U.S.A.

on the base mineral oil aids the improved oils in resisting oxidation and preventing rust formation, and gives both stability after long time storage and long service life. The oils separate easily from water, do not foam, and are non-corrosive to bearings. The rust inhibitors "plate out" on metal surfaces, forming a film impervious to the rusting action of moisture and air. Even after considerable periods of service, the oils still pass rusting tests with distilled water and synthetic sea water. Tests have shown the new oils to be many times more resistant to oxidation than turbine oils not containing inhibitors.

—E-77—

I DESIRE MORE INFORMATION

Included in this section is a coupon which can be used by you in obtaining additional information on any article that appears in the News Supplement. At the close of each item, on which information is obtainable, appears a key reference number (Example: E12) Simply mark the reference number on the coupon, complete your address data and return to us.

BLAW-KNOX BUILDS BIG BITE BUCKETS

Two of these giant clamshell buckets have just been built by Blaw-Knox Company for a coal company on Lake Superior and are to be used on a bridge-type crane to transfer coal from lake boats to dock storage. Believed to be the largest clamshell buckets ever built, they are rated to handle 23 cubic yards, or 17½ tons of coal. Three bites will load a hopper car.

INTRODUCE RECORDERS FOR 25-CYCLE CURRENT

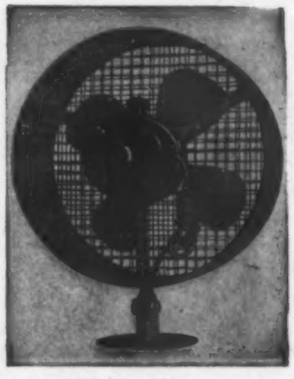
▲ Extensive steel processing economies are emphasized in the introduction by Brown Instrument Company of a 25-cycle operation strip chart electronic potentiometer, designed for steel mills operating on a 25-cycle current.

The new instrument, announced by John R. Green, manager of the steel and ceramics division of the Philadelphia subsidiary of Minneapolis-Honeywell Regulator Company, is being introduced to meet special industry requirements.

"The economies which the new 25-cycle electronic potentiometer makes possible," said Green, "will consist chiefly in providing accuracy, dependability and freedom from vibration which are inherent in the electronic form of temperature measurement, and will eliminate the need for frequency converters that were required in the application of present-day electronic potentiometers on 25-cycle current."

The 25-cycle operation potentio-

IS HEAT SLOWING UP YOUR WORKMEN?



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep Them COOL with TRUFLO FANS

TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY
554 MAIN ST., HARMONY, PA.

meter, latest addition to the growing line of Brown strip chart "ElectroniK" models, will be shipped this month in standard speeds, single and multiple models. Fast speed models for 25-cycle operation will be made available by the Brown company later.

In pointing up the importance of this new development in the electronic instrument field, Mr. Green stated that although a number of steel mills operate on 60-cycle current a high percentage of the industry is equipped only with 25-cycle.

"The new development," said Green, "is a further indication that the Brown company has laid down a program to provide electronic recording facilities for a whole industry. While doing so, the company is seeking ways and means for the steel industry to balance off, wherever possible, increasing production costs, in this case costs which are unnecessary when employing instruments tailored to the needs and facilities of a representative group of the steel industry."

The new 25-cycle instruments, operating at standard speed, will be available with all standard thermocouple actuations or radiation variations, as well as with auxiliary contacts.

—E-79—

ELECTRONIC TACHOMETERS INDICATE SPEED ROTATION

▲ A new electronic tachometer designed for measuring rotating speeds from 300 to 50,000 rpm has been announced by the special products division of the General Electric Company. Weighing only 19 lb, the new tachometer is useful for the production testing of equipment instantaneously without the necessity for any permanent attachments. It can be used to indicate the speeds of electric motors, machine tools, automotive and aircraft engines, pumps, fans, blowers and other types of rotating equipment.

The electronic tachometer consists of a small pick-up head, six feet of flexible cable, and a measuring unit with a panel-mounted indicating instrument reading directly in rpm. Either a low-speed or high-speed head can be used with the instrument. The low-speed head provides five speed ranges, 0-1000, 0-2000, 0-5000, 0-10,000, and 0-20,000 rpm, while the high-speed head provides three speed ranges, 0-10,000, 0-20,000, and 0-50,000 rpm.

The electronic tachometer consists of a small pick-up head, six feet of flexible cable, and a panel measuring unit.

Each pick-up head consists of a light-interrupting disk and a phototube. Light shining upon the phototube through the openings in the rotating disk produces input signals which are then transferred to the measuring unit, which indicates the rpm of the equipment being tested. The shaft to which the disk is attached rotates on ball bearings and requires very little torque, and therefore the speed of the equipment being measured is not reduced by use of the tachometer.

—E-80—

BOOK REVIEW . . . NEW SAFETY DIRECTORY

▲ The Alfred M. Best Company announces that the first annual edition of "Best's Safety Directory" — the first complete reference volume of its kind of all known safety products — is now off the presses and ready for distribution.

Best's Safety Directory accomplishes all this by:—

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2. Describing the hazard and the "remedy."
3. Pointing up the need and field of use of each product.
4. Giving the names and addresses of manufacturers, distributors and local dealers.

Best's Safety Directory is priced at $5.00 and can be obtained from the home office of the Alfred M. Best Company, New York, New York.

BOOK REVIEW . . . SCIENTIFIC INSTRUMENTS

▲ "Scientific Instruments" discusses a wide range of instruments designed for making physical measurements. Not only laboratory instruments but also those used in the field, in industry and commerce are well covered. In addition to the description of the various instruments, much space is devoted to the discussion of the principles on which they are based and to methods of measurement. All this information is given in clear and simple language so that not only workers of specialized fields, but also non-professional readers will find this book very interesting and instructive. The book is published by the Chemical Publishing Company, Brooklyn 2, New York. 304 pages, $6.00.

ELECTRIC TRUCK SAVES MEN FROM HIGH HEAT

▲ Heat treating of forged valve parts, a cumbersome job by manual methods requiring excessive manhours and the exposure of at least two men per piece to terrific furnace heat, has been solved at Edward Valves, Inc.'s East Chicago, Indiana, plant by the use of electric powered fork trucks.

Bulky forgings of all sizes, shapes and weights are now handled easily and quickly by one operator and a Clark fork truck. In both loading and unloading operations the forks of the trucks are inserted directly into the furnace under terrific temperatures.

In removing the pieces from the furnaces the forks must handle the heavy forgings preheated to as high as 1600 F while carrying them to the cooling beds, yet the operation has never caused distortion of either forks or other parts.

The same type of trucks are used to handle the huge forging dies into and out of the hammers, replacing former slower methods and resulting in reduced production costs. All die changes in the Edward forge shop are handled with the 4,000 lb electric carloader type fork truck with 36 in. fingers and a 108.in. lifting height.

Fork truck removing a solid steel valve cover 31 in. diameter, 7 in. thick, weighing 1400 lb and heated to 1600 F from furnace to transport to cooling beds.

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Avoid Waste and Confusion!
SAVE TIME
STOP DELAYS
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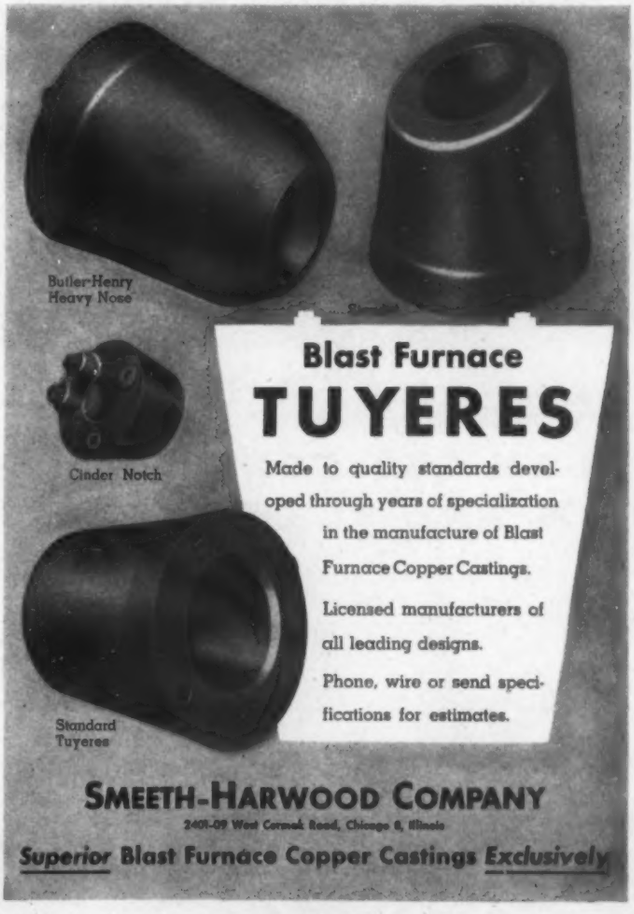
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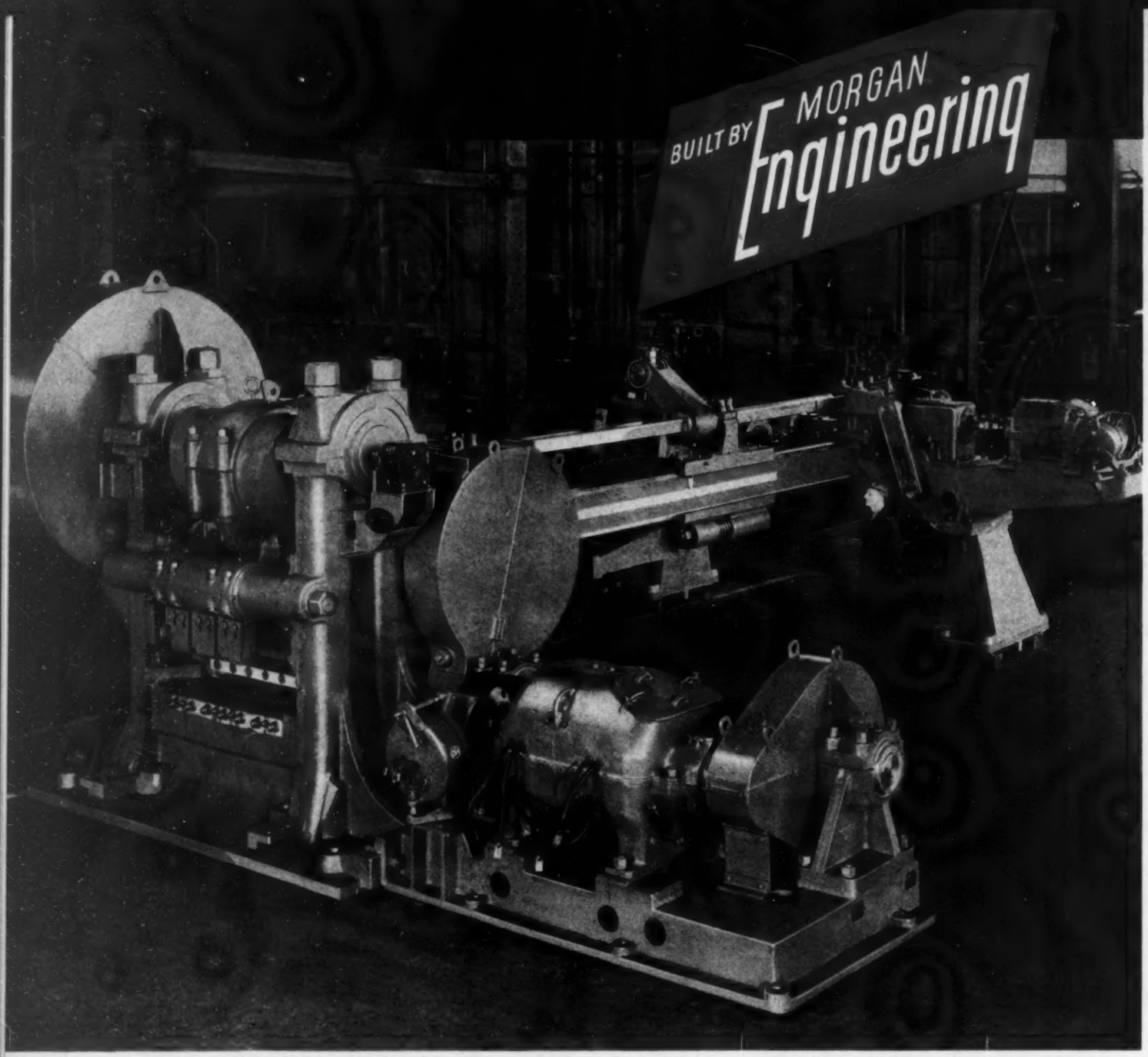

MORGAN 450-TON BLOOM AND SLAB SHEAR

● Among the many types of mill equipment built by Morgan, is the 450-Ton Bloom Shear illustrated above for shearing 12″ x 12″ blooms and equivalent slab sections. Shear is designed without flywheel or clutch for start and stop operation. Hold-down gag is of the independent hand adjusted type. A motor operated gauge is provided for gauging lengths from 2′0″ to 15′0″. Of massive construction, this shear is typical of the types of mill equipment Morgan designs and builds.

THE MORGAN ENGINEERING CO.
ALLIANCE, OHIO. 1409 Oliver Building, Pittsburgh

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C. W.

Personnel News . . . .

Harry W. McQuaid has established consultant services covering process and product development in electric furnace melting; oil production metallurgy; steel processing; plated and hot dip coatings; automotive metallurgy; free machining steels; farm implement metallurgy; and metallurgical factors in design. Mr. McQuaid will make his headquarters in the Union Commerce Building, Cleveland 14, Ohio.

Mr. McQuaid has had wide metallurgical experience in his years with Republic Steel Corporation and its predecessors, Central Alloy Steel Corporation and United Alloy Steel Corporation. He is one of the originators of the McQuaid-Ehn classification of grain size in steel.

Arthur Landis was appointed general superintendent of the Christy Park works of United States Steel's National Tube Company. This McKeesport plant suspended operations soon after V-J Day, after producing a record of 27 million shells and bombs during the war. It is re-opening on a very restricted basis, with operations limited to specialized production of high pressure cylinders for which the company has received a few orders.

Mr. Landis has wide experience in manufacturing and steel fabrication. For 14 years he was vice president in charge of manufacture for Auburn Automobile Company. He managed two Brooklyn, New York, plants of Sperry Gyroscope Company in World War II.

A native of Oxford, North Carolina, he served five years in the Navy following his graduation from the United States Naval Academy in 1915. He took postgraduate studies in engineering and business administration.

Before joining National Tube, he was vice president in charge of operations of Snead & Company, Orange, Virginia, sheet metal and light structural steel fabricators.

C. W. Meyers has resigned from his position as district manager of the Republic Steel Corporation's central alloy district to become president of the Colorado Fuel and Iron Corporation, Pueblo, Colorado.

Mr. Meyers first became associated with the upper works of the Carnegie Steel Company, Youngstown, Ohio in 1907, and in 1918 went with the McDonald Mill in Youngstown, where he stayed until 1931, the last eight years as superintendent. In 1931, he joined the Republic Steel Corporation as superintendent of the rolling mill at Chicago, and in 1933 was transferred to Youngstown, at that time, the general offices of the Republic Steel Corporation. In 1934 he was made assistant district manager of the central alloy district, and in October 1937 was made district manager. In 1942 Mr. Meyers was given a leave of absence to serve as special assistant to **H. G. Batcheller**, director of the steel division of the War Production Board.

George W. Putnam, assistant district manager of the Central District of Republic Steel Corporation, has been appointed district manager.

Mr. Putnam succeeds **C. W. Meyers** who has resigned to become president of the Colorado Fuel and Iron Company. Mr. Meyers has been with Republic since 1931.

Walter M. Farnsworth, divisional superintendent, and **E. R. Johnson**, district chief metallurgist, have been named assistant district managers.

Mr. Putnam was born in Brinkhaven, Ohio, received his public school education in Millersburg, Ohio, and graduated from Ohio State University with the degree of bachelor of mining engineering. After graduation he joined the Wheeling Steel Corporation as a furnace helper.

From 1921 to 1923 he was a state highway engineer and in 1923 joined the American Rolling Mill Company as a combustion engineer. He was later made assistant of the open hearth at Middletown and in 1930 superintendent of the open hearth at Butler, Pennsylvania. He joined Republic as open hearth superintendent of the Youngstown District in 1933. In 1937 he was made assistant district manager of the Warren District and two years later assistant district manager of the Central district.

Mr. Farnsworth, assistant district manager, will also be assistant district manager of the Chicago district and will have charge of the electric furnace operation both in Republic's Central and Chicago districts.

Born in Nashville, Tennessee, Mr. Farnsworth has been in the steel business since 1914. He attended the Nashville public schools and joined the metallurgical department of the Illinois Steel Company in Chicago in 1914.

During the next six years he worked in the chemical laboratory of the electric furnace melt shop and, upon

C. W. MEYERS

GEORGE W. PUTNAM

WALTER M. FARNSWORTH

E. R. JOHNSON

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leaving, joined the Timken Roller Bearing Company as a melter. He was with Timken five years in that position and joined Republic's predecessor company in 1925. He has served as superintendent of the No. 1 electric furnace melt shop, as divisional superintendent in charge of the Canton steel division, and divisional superintendent in charge of the Canton steel division blast furnace and coke plant.

Mr. Johnson was born in Chicago and attended public schools in Chicago, Detroit and Harvey, Illinois. He was graduated from the University of Michigan in 1921 as a bachelor of science and chemical engineering, and received his master's degree in 1922.

In that year he joined Central Steel Company and in 1925 entered its metallurgical laboratory. He was made superintendent of the metallurgical laboratory in 1926, assistant chief metallurgical engineer in 1929, and district chief metallurgical engineer in 1944.

O. A. Bamberger succeeds Mr. Farnsworth as divisional superintendent of the Canton plant. Mr.

O. A. BAMBERGER

Bamberger, formerly superintendent of Republic's Massillon plant, has been with Republic and its predecessor companies for more than 25 years.

H. Ward Lewis was appointed supervisor of operations for Pittsburgh Limestone Corporation, New Castle, Pennsylvania.

Clifton A. Pratt was named superintendent of the company's Kaylor Limestone Mine in Armstrong County, Pennsylvania, succeeding Mr. Lewis.

Mr. Lewis has been with the company since 1920 as engineer, assistant superintendent and superintendent. He is a native of Westminster, Maryland, and is a graduate of Western Maryland College and also the University of Michigan where he received a civil engineering degree. He saw service in World War I.

Mr. Pratt is a native of Waltham, Massachusetts, and holds a civil engineering degree from Rose Polytechnic Institute. He joined Pittsburgh Limestone in 1939 as a plant mining engineer. He attained the rank of lieutenant colonel in the United States Army Engineers in World War II, being in service nearly five years in the American, European and Pacific theaters of war.

C. W. Baker was appointed assistant chief engineer of the Lewis Foundry and Machine division of Blaw-Knox Company at Groveton, Pennsylvania.

Mr. Baker has been on the engineering staff of Lewis Foundry & Machine since 1929, having been previously employed in an engineering capacity by other companies in this area. His new duties will include specializing in design of Lewis products.

George R. Park, formerly with Spang-Chalfant division of National Supply Company, Ambridge, Pennsylvania, as a bearing specialist, is now superintendent of maintenance for Magnolia Metal Company, Elizabeth, New Jersey.

Mr. Parks is now collecting equipment and machinery for new plant-extension now being constructed for the manufacture and rebabbitting of precision-bonded babbitt bearings, slides, and wearing plates.

R. J. Leckrone was appointed chief engineer in charge of engineering and machinery sales for the

R. J. LECKRONE

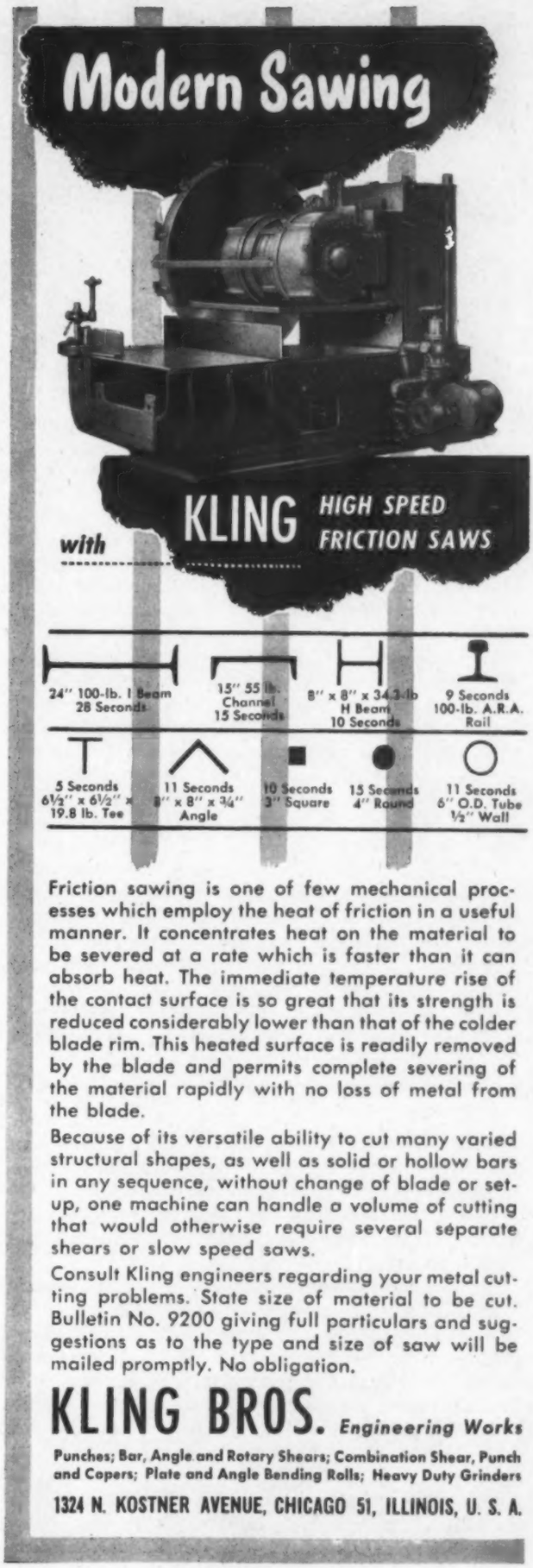
Pittsburgh Steel Foundry Corporation, Glassport, Pennsylvania.

Mr. Leckrone, a mechanical engineering graduate of the University of Pennsylvania, goes to Pittsburgh Steel Foundry from the Lewis Foundry and Machine division of the Blaw-Knox Company, which he served for the past eight years in the capacity of chief designing engineer.

Previous to that, Mr. Leckrone was affiliated with the Continental Foundry and Machine Company, Pittsburgh, Pennsylvania, as a special engineer, following his return from Russia at the close of a three year contract as chief engineer in charge of American specialists in the design and installation of rolling mill equipment for the U.S.S.R. at Kramatorskie, in the Ukraine.

In his association with the Pittsburgh Steel Foundry, Mr. Leckrone will head the Company's engineering activities for both its plants, at Glassport and McKeesport, Pennsylvania, as well as its sales activities in the general machinery field.

V. E. Cribbs has been appointed assistant to director of personal relations for American Rolling Mill Company, and **Ralph J. Wright** has been appointed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ROBERT POTTER

RALPH J. WRIGHT

V. E. CRIBBS

assistant to manager of Armco's Middletown division.

Mr. Wright joined the organization as a messenger in Armco's main office in 1917. He was made a weighmaster in 1918 in the open hearth department and in 1920 accepted the assignment of stenographer in the maintenance department. He was connected with the medical department in 1924 as a clerk and became compensation clerk the following year. In 1927, he was appointed assistant supervisor of the personal records department. He became chief interviewer in the employment department that same year, which position he capably filled until 1944, when he was further advanced to the responsibilities of assistant supervisor of personal relations. He held this position until his most recent promotion.

Mr. Cribbs' first connection with Armco was in 1920, as a laborer in the east works shipping department. In 1922 he was transferred as a clerk in the service engineering department and the following year became an instructor in the training department. He was made assistant supervisor of training in 1924 and supervisor in 1927. He advanced to the position of supervisor of personal relations at east works in 1928, and in 1932 he was made assistant to the works manager of the Middletown division, which position he has held until the present advancement.

Robert Potter, formerly chief engineer of the rolling mill division of E. W. Bliss Company in Salem, Ohio, has been appointed manager of this division.

Prior to his joining the Bliss organization in January of this year, Mr. Potter was chief engineer of Superior Steel Corporation.

A. D. Shankland, assistant general manager, Bethlehem Steel Company has been transferred to the staff of Quincy Bent, vice president at Bethlehem, Pennsylvania. **V. J. Pazzetti, Jr.,** superintendent, Saucon division, and **J. A. Taylor,** chief engineer, have been appointed assistant general managers at Bethlehem plant. **S. D. Gladding,** superintendent, alloy and tool steel division, becomes superintendent of the Saucon division, and will be succeeded by **Ralph E. Knerr,** now assistant superintendent. **J. A. Bell** succeeds Mr. Taylor as chief engineer.

Mr. Shankland has been with Bethlehem since 1914 and served in various capacities until 1928, when he was appointed superintendent of the alloy and tool steel division. In 1934 he became engineer of tests and in 1945 assistant general manager.

Mr. Pazzetti was first employed by Bethlehem in 1913. In 1922 he was made superintendent of Nos. 2 and 4 open hearths and in 1936 superintendent of the Saucon division.

Mr. Taylor has been with Bethlehem since 1924. In 1938 he became superintendent of the Forge Specialty Department, in 1942 superintendent of the lower manufacturing shops, and in 1945 chief engineer.

Mr. Gladding entered the employ of Bethlehem in 1914. He was made superintendent of the small mills, alloy division, in 1926, and superintendent of the alloy and tool steel division in 1934.

Mr. Knerr has been with Bethlehem since 1920. He became superintendent of the Lehigh mills in 1939 and assistant superintendent of the alloy and tool steel division in 1946.

Mr. Bell came to Bethlehem in 1906 and has served in the engineering department in various capacities. In 1939 he was advanced to chief draftsman and in 1945 to assistant chief engineer.

H. E. Slocum, director of chemical laboratories for the Jones and Laughlin Steel Corporation, has retired

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after 49 years service with the Corporation and over 50 years association with the chemical and metallurgical field of the steel industry. Mr. Slocum was associated with the Carnegie Steel Company and the National Tube Company before coming to Jones and Laughlin in 1897 as a chemist at its Pittsburgh works. In 1914 he was appointed chief chemist of the Pittsburgh works and in 1936 was made director of chemical laboratories.

H. R. McLaren, formerly superintendent of tube mills, has been made assistant general superintendent, Steel and Tube division, Timken Roller Bearing Company, Canton, Ohio; **J. P. Wargo,** assistant superintendent of tube mills and finishing departments, becomes superintendent of tube mills; while **R. R. Elsasser,** until recently manager of the company's war-born Newton Falls, Ohio, plant, will be assistant superintendent of tube mills.

Mr. McLaren a native of Ben Avon, Pennsylvania, is a 1923 graduate of Carnegie Institute of Technology with a bachelor of science degree in metallurgy. Following his graduation, he spent two years doing research in the zinc works of the American Steel and Wire division of the U. S. Steel Corporation, before going to Ellwood City, Pennsylvania, where he became general foreman of hot mills for the National Tube Company. In 1929 he went to Lorain, Ohio to become superintendent of National's seamless tube mills there. Then, in 1930, he became piercing mill superintendent for the Timken Steel and Tube division, from which post he was promoted to superintendent of tube mills in 1937.

Mr. Wargo, born in Bridgeport, Connecticut, was graduated in 1925 from the Carnegie Institute of Technology with a degree in metallurgical engineering, before joining the National Tube Company in Ellwood City, Pennsylvania, where he became chief inspector and, in 1934, superintendent of the finishing department. In 1936, he came to the Timken Company as an inspection engineer. During the war he was superintendent of the Timken Ordnance Company.

Graduated in 1935 from Ohio State University, with a bachelor of science in chemical engineering, Mr. Elsasser, a native of Bucyrus, Ohio, became a Timken sales trainee and a member of the steel sales force until 1942, when he went to the steel inspection engineering

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department. In 1943 he was transferred to the Gambrinus metallurgical department, and in 1944 went to Newton Falls, Ohio, as manager of the Timken wartime branch there.

John J. Stone, 59, special products engineer, Bethlehem, Pennsylvania plant, Bethlehem Steel Company, died August 31 at Brandon, Vermont. Mr. Stone was connected with Bethlehem Steel Company since July 1, 1911 when he was first employed as assistant foreman of treatment, armor plate department.

In 1916 Mr. Stone was made superintendent of the armor plate department at Bethlehem plant and advanced successively through the positions of assistant superintendent of forges and foundries and superintendent of forges and foundries until, in 1938, he was made special products engineer, which position he occupied at the time of his death.

Mr. Stone was born April 18, 1887 in Sioux City, Iowa. He graduated from Stephens Institute of Technology in 1911 with the degree of mechanical engineer.

C. M. Taylor has been elected executive vice president of the Lincoln Electric Company.

Mr. Taylor has been with the Lincoln Electric Company since 1916, having been granted a leave of absence for service in World War I. He enlisted in the Air Corps in 1917 and returned at the end of the war, when he became a foreman. Later he was placed in charge of the company's time study and methods department, advanced to assistant superintendent and then superintendent. In 1928, he was appointed vice president in charge of sales and has served on the board of directors since 1927.

W. E. Lewis, vice president of the Pittsburgh Lectromelt Furnace Corporation has been placed in charge of the newly opened Chicago branch office. Mr. Lewis has been associated with the company for the past 25 years. The new office, located at Room 307, 309 North Michigan Avenue, is equipped to promptly take care of all inquiries pertaining to sales and service in the Chicago territory. The Pittsburgh Lectromelt Furnace Corporation manufactures electric arc melting furnaces for the ferrous industry and smelting and refining furnaces for the ferro alloy and carbide industries.

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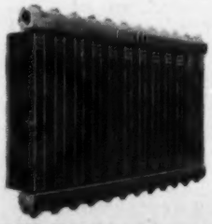

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In the making of Okobestos electrical-grade refined pure asbestos is felted and impregnated with flame and moisture-resisting compounds. Where required, a wall of heat-resisting varnished cambric is used as the principal dielectric element and a second wall of felted asbestos added. Over these layers, a protective covering is applied which may be a heavy asbestos braid, a cotton braid or a lead sheath.

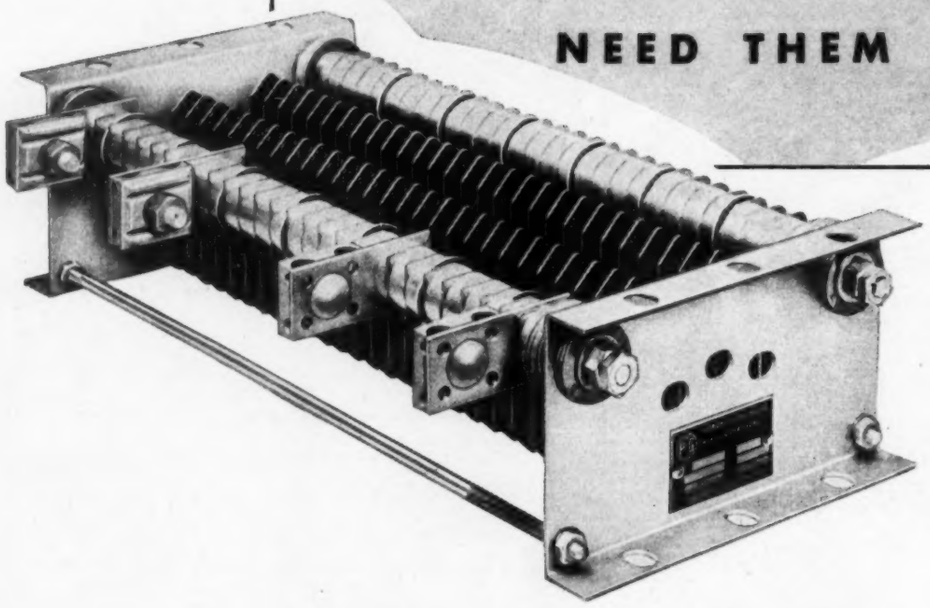
To meet specific conditions, Okobestos wires and cables may be furnished with all-asbestos insulation and asbestos braid, with all-asbestos insulation and lead sheath, with Okoseal synthetic resin insulation and in other constructions.

Write for Bulletin OK-2061 which gives detailed descriptions of principal standard constructions and the voltages, operating temperatures and locations for which each is recommended. Address The Okonite Company, Passaic, N. J.

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

E, I and R Values

WHERE AND WHEN You NEED THEM MOST



★ ALL STEEL CONSTRUCTION
★ MICA INSULATION
★ RUGGED TERMINALS
★ PROVISION FOR EXPANSION
★ ADEQUATE VENTILATION
★ UNAFFECTED BY VIBRATION
★ MOISTURE RESISTANT
★ CORROSION PROTECTED

Write for Bulletin No. 500

The resistance grids used for P-G STEEL GRID RESISTORS are produced in a wide variety of values, thus the current requirements for accurate motor control are readily obtained. These resistors, built of steel and mica, are able to withstand vibration, moisture or corrosive fumes, and maintain remarkably constant electrical values. Hence, they are the "Trouble Free" resistors with the longer service life. Try P-G on your next application.

P-G

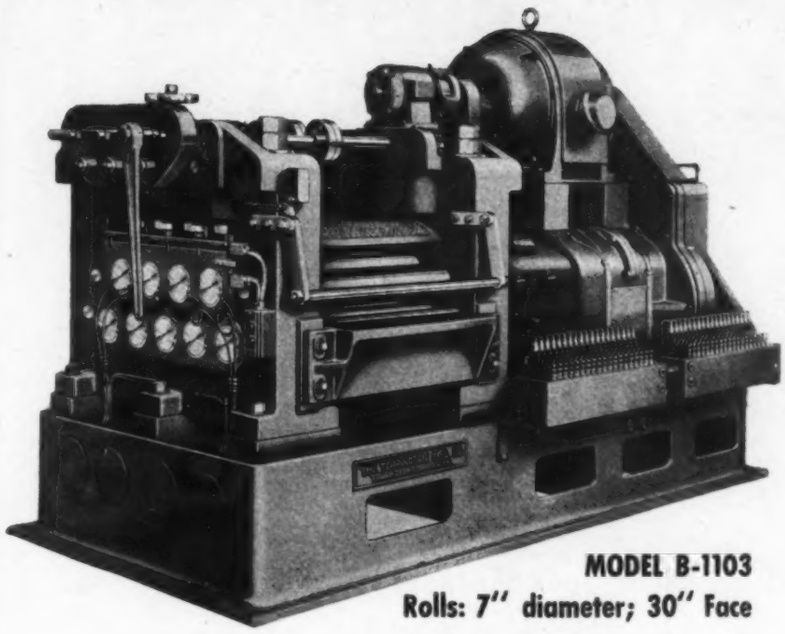
The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

Another TORRINGTON *Special*



MODEL B-1103
Rolls: 7" diameter; 30" Face

FLATTENING MACHINES

These multi-roll machines are designed to remove the buckles and waves from slab, strip and sheet metal, producing it commercially flat. There are twelve standard models, varying in size, and special machines can be built to fit specific requirements. Standard models are 9 roll (5 lower, 4 upper) but can be built with 5, 7, 11, 19 or 23 rolls, if necessary. Also the machines may have feed rolls on one side or both sides.

FOR OVER 60 years, Torrington Manufacturing has been designing and building special machinery for processing sheet, strip, flat wire, rods and tubes, as well as air-cooled or water-cooled molds for casting copper-bearing alloys. Fine modern facilities include a highly trained design and engineering staff, pattern shop, forge shop, hardening room, welding shop, completely equipped machine shop, and large assembly floor covered by cranes. Experienced, skillful men work under ideal conditions. Our standard designs can be modified to meet special requirements and we work closely with customers' engineers in adapting machines or designing and building new machines. This collaboration assures special attention to maintenance and production problems.

Privacy is guaranteed when we build from customers' drawings or design and build under their supervision. Materials and workmanship are also guaranteed. Call or write Torrington Manufacturing with complete details of your requirements. We'll not only build a machine to suit your specifications, but will also help set it up and start it in production in your plant.

MODEL B-1103
FEATURES

CAPACITY: (Metal 30,000 lbs. P. S. I. tensile strength—24" wide.) Thickness: Minimum .312" to Maximum 1.000".
Length of rolls can be made to suit, within reasonable limits.

SPEED varies with horse power and specific conditions. 60 H. P. motor recommended for 100 ft. per min. metal speed at above metal specification.

ROLLS are interchangeable, all positively driven. Are of either unhardened alloy steel or special tool steel hardened to 60-63 Rockwell C range, as desired.

SPINDLES: Each roll is connected to its driving pinion by a spindle having flexible connections for ease of adjustment and to compensate for wear.

ADJUSTMENT: Each upper roll is adjustable in parallel, with provision for alignment. Mechanism for adjusting all upper rolls as a unit may be added. Indicators show degree of adjustment.

GUIDE TABLE at entry and exit and guard rolls on both sides.

DRIVE MOTOR is located over pinion housings, saving floor space, at right or left hand side of machine as desired. Drive from motor to pinions is through double helical gearing or chains and sprockets. No clutch required.

OTHER FEATURES: Roll housings capped for easy removal of upper rolls. Entire drive including spindles is enclosed. All bearings sleeve-type bronze.

The **TORRINGTON**
MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT

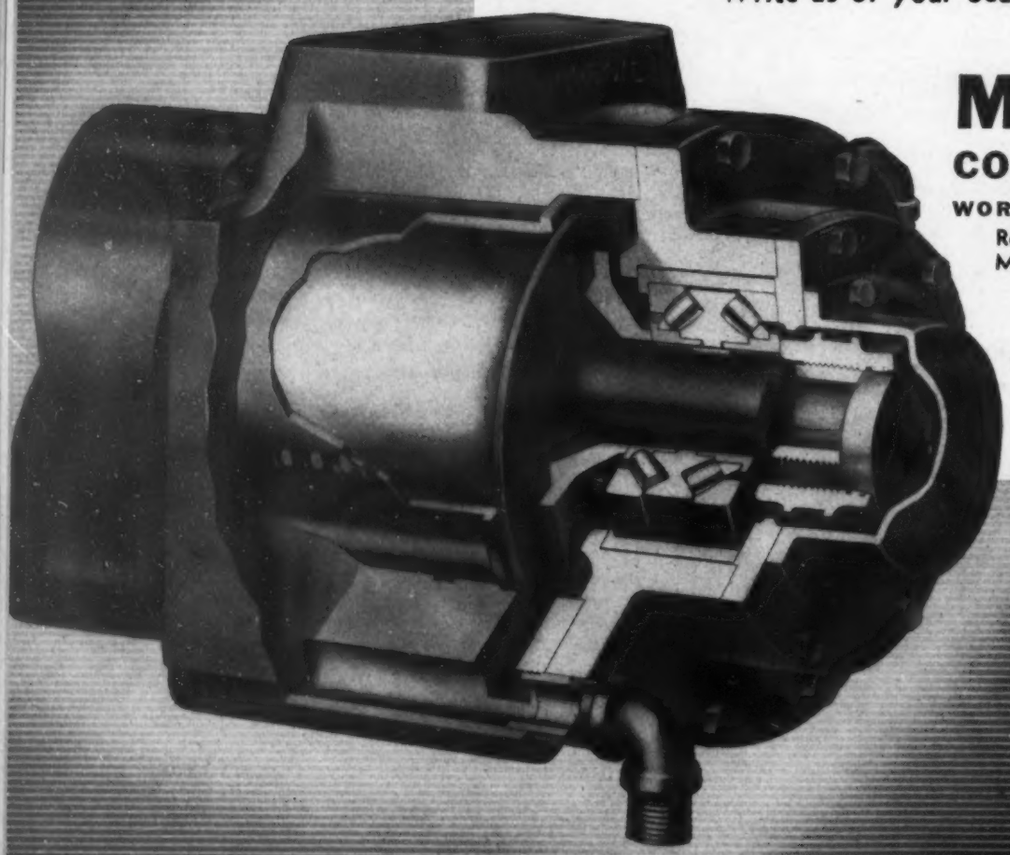
Discuss Morgoil Bearings with Users

. . . then with Us

Before committing yourself to any type of roll neck bearing we invite you to talk with users about Morgoils. Morgoil roll neck bearings are the only bearings that deliver all the advantages of other types and, in addition, give benefits no other bearing can offer.

Morgoils are used on all types of 2-high and 4-high hot and cold mills. The extent to which they are replacing other types of bearings in old and new mills is clear proof of their superiority

Write us of your bearing problem.



MORGAN
CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS
Rolling Mills - Wire Mills - Gas Producer
Machines - Regenerative Furnace Control
MB-3

English Representative:
International Construction Co.
56 Kingsway, London, W. C. 2, England

HAIRPIN PICKLING HOOK used in prominent steel plant for handling wire coils. Fabricated from standard mill forms of Monel by The Youngstown Welding & Engineering Company, Youngstown, O., this lightweight hook is ideal for heavy-duty service.

DESIGNED FOR LONG LIFE

Now you can have a lightweight pickling hook! One that's as strong as any you've ever used. One that's more corrosion-resistant than many heavier hooks. One that's designed for real economy.

Made of Monel by* **The Youngstown Welding & Engineering Company,** *Youngstown, Ohio, the streamlined pickling hook illustrated here handles a 3000-pound load easily . . . and with enduring safety.*

Monel resists the corrosive action of hot pickling acids. It has the high strength and toughness required by equipment that is subject to strain and stress. Monel hooks last despite bumps and jolts that fracture less ductile metals.

When balky, old-fashioned equipment stalls production or requires costly maintenance, there's a good chance that Youngstown can suggest an improved, lightweight design in Monel to meet your needs.

Why not write them — or us — for further information about economical, trouble-free pickling equipment? *Reg. U. S. Pat. Off.

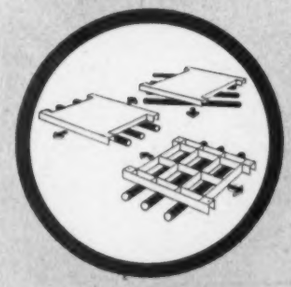
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N.Y.

MONEL... ONE OF THE INCO NICKEL ALLOYS

5000 KVA TANK
SINGLE PHASE
60 CYCLES
BOTTOMS UP for 60 seconds
Arrangement of wheels, when provided.
Liberal spacing for cleaning and painting radiators in the field.
Uni-Row Radiators permanently welded to tank.
13 Gauge oval tubes welded to 11 Gauge headers assure strong leakproof welds.
Steel braces damp vibrations during shipping and service.

TO JACK

Steel Jack Lugs are provided on all four corners. Due to its sturdy, all welded construction, the base will not be distorted or twisted when jacked from any corner.



TO ROLL

Large structural shapes with flat surfaces will engage any roller — wood or metal. Rollers can be placed at any angle to move transformer in any direction.

TO PULL

Lugs with removable pins may be provided to accommodate slings, chains or hooks. Otherwise, shackles can be inserted into holes of jack lugs to pull transformer.

TO SKID

Base of flat structural steel shapes will skid on flat surfaces, on rails, on steel strips, plates, etc.

Base Formed of Heavy Structural Steel Shapes Welded Together and to the Bottom of the Tank

YOU don't often view a large Power Transformer from underneath. However, it is one way of finding out if a Transformer is designed right and built right from the bottom up. We present this one minute study to acquaint you with some of the basic reasons for the ever increasing popularity of Pennsylvania Transformers among Industrials and Utilities.

Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

808 RIDGE AVE. • PITTSBURGH 12, PA.

ASSOCIATION OF IRON AND STEEL ENGINEERS

DISTRICT SECTION MEETINGS

November

Birmingham District — Monday, November 25, 1946

"Engineering Properties of Cast Iron," by Dr. J. T. MacKenzie, American Cast Iron Pipe Company, Birmingham, Alabama

Buffalo District — Tuesday, November 12, 1946

"The Regulex Generator and Its Function in Steel Mill Control," by T. B. Montgomery, Engineer in Charge of Control Engineering, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin

Chicago District — Wednesday, November 13, 1946

"Power Cycles and Power Generating Equipment," by A. R. Smith, Managing Engineer, Turbine-Generator Division, General Electric Company, Schenectady, New York

Cleveland District — Monday, November 18, 1946

"Trends in Modern Marine Power Plant Design," by Frank V. Smith, Cleveland, Ohio.

Detroit District — Tuesday, November 12, 1946

Maintenance Symposium — Chairman: J. A. Shimmin, Rotary Electric Steel Company, Detroit, Michigan

"Build-Up Welding," by M. R. Scott, Supervisor of Process Service, Linde Air Products Company, Detroit, Michigan

"Lubrication," by E. R. Brandau, Industrial Lubrication Service Engineer, Gulf Refining Company, Detroit, Michigan

"Electrical Maintenance," by Clarence E. Baxter, Assistant Chief Electrician, Great Lakes Steel Corporation, Blast Furnace Division, Ecorse, Michigan

"Mechanical Maintenance," by L. D. Hoadley, Assistant Master Mechanic, Great Lakes Steel Corporation, Blast Furnace Division, Ecorse, Michigan

"Maintenance Housekeeping," by H. S. Noling, Plant Engineering Department, Rotary Electric Steel Company, Detroit, Michigan

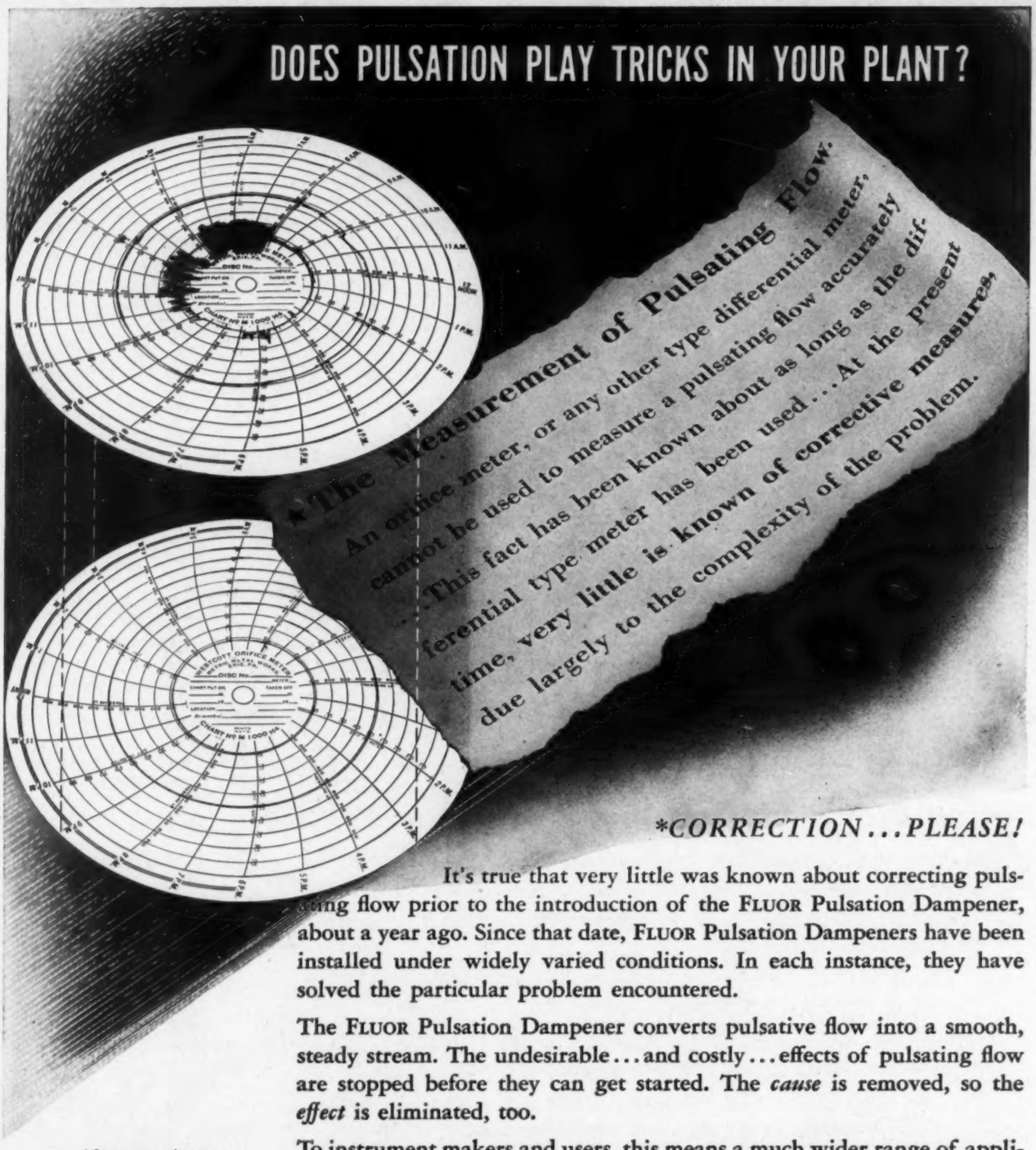
Philadelphia District — Saturday, November 2, 1946

"Problems of Installation and the Inspection of Steel with 2,000,000 Volt X-Ray Equipment," by Lovell Gardenas, Radiographer, The Midvale Company, Philadelphia, Pennsylvania

Pittsburgh District — Monday, November 18, 1946

"Effects of War on the Steel Industry of Germany," by Julius E. Graf, Assistant Chief Engineer, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

DOES PULSATION PLAY TRICKS IN YOUR PLANT?


*The Measurement of Pulsating Flow.
An orifice meter, or any other type differential meter, cannot be used to measure a pulsating flow accurately ...This fact has been known about as long as the differential type meter has been used ...At the present time, very little is known of corrective measures, due largely to the complexity of the problem.

*CORRECTION ... PLEASE!

It's true that very little was known about correcting pulsating flow prior to the introduction of the FLUOR Pulsation Dampener, about a year ago. Since that date, FLUOR Pulsation Dampeners have been installed under widely varied conditions. In each instance, they have solved the particular problem encountered.

The FLUOR Pulsation Dampener converts pulsative flow into a smooth, steady stream. The undesirable ... and costly ... effects of pulsating flow are stopped before they can get started. The *cause* is removed, so the *effect* is eliminated, too.

To instrument makers and users, this means a much wider range of application for all types of differential meters ... and more accurate measurement by every meter installed ... wherever a FLUOR Pulsation Dampener is used. If you want to know more about this proved way to keep your meters honest—and to eliminate many other effects caused by pulsative flow in gas, air and vapor lines—write for the new FLUOR Bulletin PD-1.

*Statement from a recently published Engineering Handbook

BE SURE WITH FLUOR — SINCE 1890

See the FLUOR Exhibit at the Power & Mechanical Engineering Exposition, New York, December 2 - 7.

FLUOR PULSATION DAMPENER
U.S. PAT. NO. 2,405,100

THE FLUOR CORPORATION, LTD., 2500 South Atlantic Boulevard, Los Angeles 22
NEW YORK • PITTSBURGH • KANSAS CITY • HOUSTON • TULSA • BOSTON

ENGINEERS • MANUFACTURERS • CONSTRUCTORS

There's Gold *IN STEEL SCRAP*

HERE IS THE WAY TO GET IT

Steel producers urgently need scrap.

Millions of tons of steel products that have served their usefulness are piled throughout the country. Cut it to charging box size and start it moving. Idle scrap means idle mills and idle fabricating plants.

Linde can supply the oxygen, acetylene, cutting equipment, and technical help for any scrapping operation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

1946 AISE CONVENTION and IRON AND STEEL EXPOSITION

A Pictorial Report

The 1946 Annual Convention and Iron and Steel Exposition was one of the most successful affairs ever conducted by the Association of Iron and Steel Engineers. Held October 1, 2, 3, and 4 in the Public Auditorium, Cleveland, Ohio, nearly 11,600 persons from the iron and steel and allied industries viewed the first postwar showing of the developments and progress made during the war years. Technical meetings, such as the one shown above, included 39 papers in 13 separate sessions and were very well attended.

The exposition was held in the Exhibit and Arena Halls of the huge auditorium. Shown below, left, is a view of the exhibits in the Arena. A feature of the exposition was Youngstown Sheet and Tube Company's working model of their continuous butt weld pipe mill, which is shown below, right. Among the items shown for the first time were new electrical controls, improved multiple horsepower motors, an "electric eye" gage for checking thicknesses of moving sheet stock, and a new lighting maintenance device. Labor easing equipment, improved lift trucks and air conditioned crane cabs caught the eyes of cost-conscious steel men.

R. W. McCann and H. F. Lesso, Great Lakes Steel Corporation received first place in the 1945 Kelly Award for their paper on "Influence of the Charge upon Open Hearth Furnaces." Mr. Lesso is shown above, left, with A. J. Fisher and W. H. Burr, directors of the Association. Announcement was made during the convention of the election of L. R. Milburn, electrical engineer, Great Lakes Steel Corporation, as AISE president for 1947, succeeding F. H. Dyke, assistant general manager of Wheeling Steel Corporation's Steubenville plant, shown above, right. E. M. Richards, vice president in charge of operations, Republic Steel Corporation, shown right center, delivered a stirring address at the annual banquet (shown below) in the Hotel Statler Ball Room before over 600 persons. Mr. Richards demanded that labor unions respect the sanctity of contracts in the same manner as management and business.

BOWSER
ESTABLISHED 1885

AUTOMATIC SELF-CLEANING FILTERS

for

STEEL MILLS
and other
INDUSTRIAL PLANTS

LUBRICATING OILS . . . . . .

. . . are efficiently filtered by the Fig. 822. Completely automatic self-cleaning saves labor and reduces downtime. Especially suited for long and continuous filtration cycles or where high capacity is required. Accommodates from two to six filtering elements. Porosities .002 to .006 of an inch, capacities 60 to 360 g.p.m.

COOLANTS . . . . . .

. . . are filtered with the Fig. 823. Special filtering medium for the removal of chips and abrasives. Porosities .002 to .045 of an inch, capacities 400 to 1200 g.p.m.

GENERAL PURPOSE UNIT . . . . . .

Fig. 824 handles a variety of filtering jobs up to 50 g.p.m. including cutting oils, lubricating oils and other industrial liquids. Long and continuous filtration cycle. Completely automatic self-cleaning. Wide range of porosities.

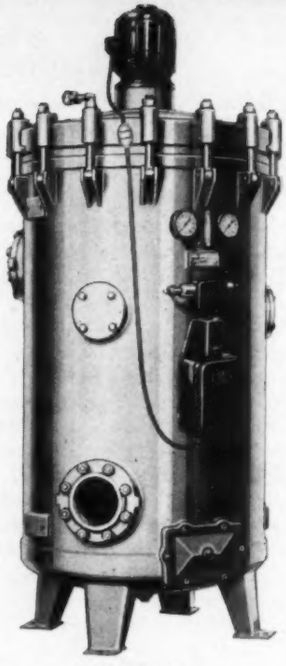
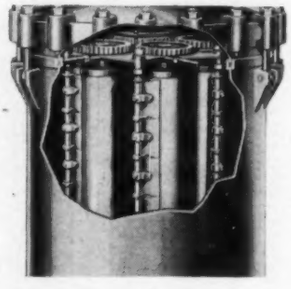


FIGURE 822



Filtering units and automatic self-cleaning system of Figure 822

The Bowser staff of engineers is available for counsel and recommendations on the specific filtering requirements of your plant. Write today.

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1314 CREIGHTON AVENUE, FORT WAYNE 2, INDIANA

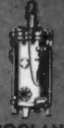
LIQUID CONTROL SPECIALISTS SINCE 1885

GENERAL PURPOSE FILTER

STORING AND DISPENSING

PIPE SEALING COMPOUND

EXPENDABLE CARTRIDGE FILTER



COOLANT FILTER

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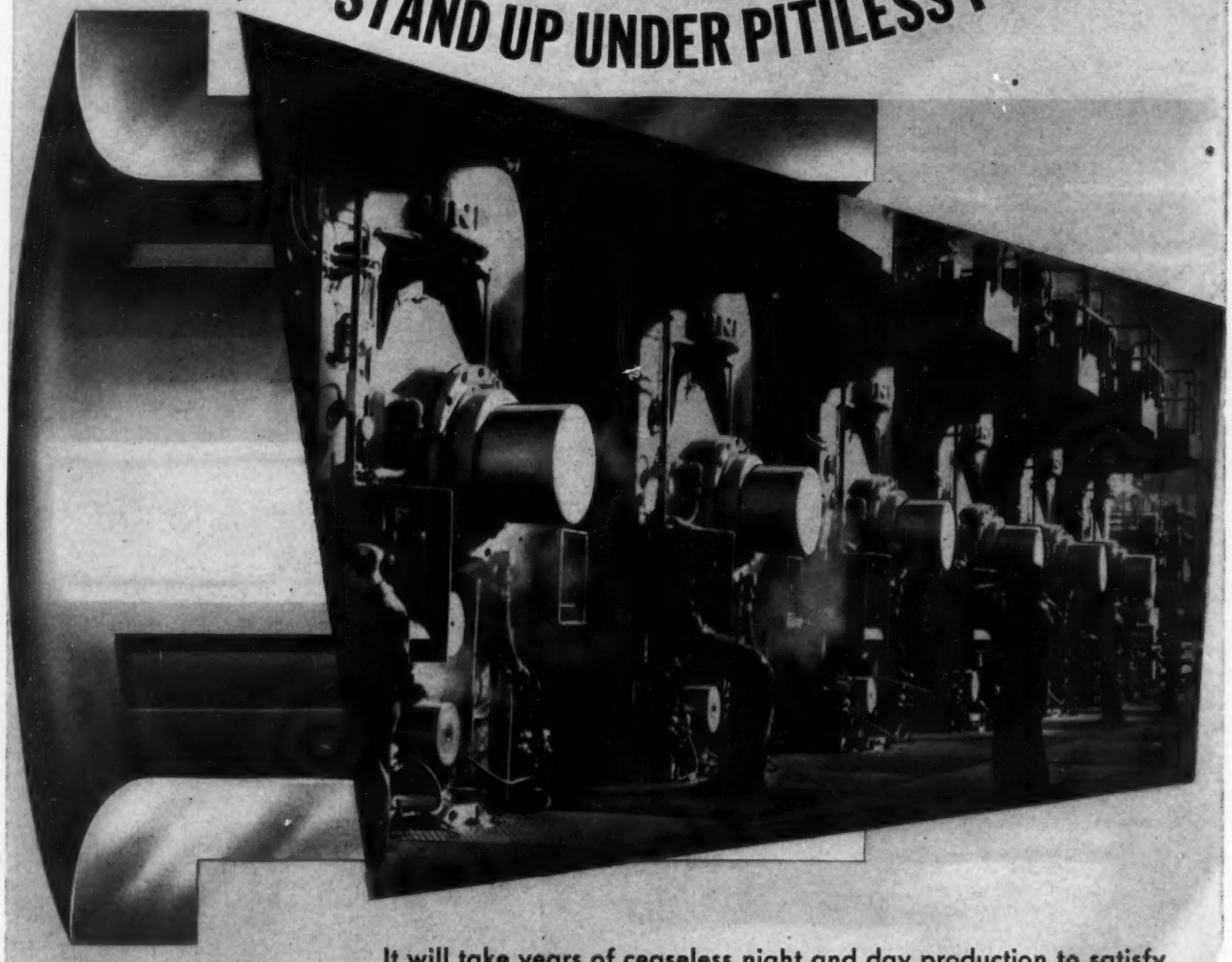
WILL YOUR ROLL NECK BEARINGS STAND UP UNDER PITILESS POUNDING?



It will take years of ceaseless night and day production to satisfy America's pent-up demand for steel. Reduce delays for roll and bearing changes by installing N-B-M #200 Bronze Bearings. Results: Up to ten times longer service—greater tonnage—freedom from cut roll necks—more uniform gauge.

Our engineers are always available to help solve your bearing problems.

N·B·M
BRONZE & COPPER CASTINGS

Blast Furnace Copper Castings
Roll Neck Bearings • Slippers
Housing Nuts • Machinery
Castings • Babbitt Metals
Acid Resisting Castings
Phosphorized Copper.

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NATIONAL BEARING
DIVISION

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AMERICAN Brake Shoe COMPANY

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

As the white outline indicates, a standard unit of nearly twice the frame size would be required to do the work of Speedaire.

$330 saving...with SPEEDAIRE

IN this Michigan chemical plant, Speedaire is doing a highly satisfactory job on pan conveyors handling limestone. Reducers run cool under heavy loads, unaffected by the lime dust. Their compactness permitted a closer hookup between machines and motors, saving valuable floor space. And compared to conventional worm-gear reducers, Speedaire saved the company $330 per unit installed.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantages of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Company, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

HODGE-PODGE CONTROL IS EXPENSIVE!

This is a typical installation of attractive, unit-type Cabinetrol.

Trim, Modern CABINETROL Cuts Installation Time and Cost

Rambling, space-taking racks are a thing of the past. Control in the *modern* steel mill is compact, centralized G-E Cabinetrol. It's attractive in design, safe to operate, and it costs no more!

Cabinetrol saves installation time and expense because it's a single, self-supporting unit. No cumbersome frames—no cluttered walls. Just one attractive, all-metal unit that will greatly enhance the appearance of your mill.

The savings in installation cost that you get with Cabinetrol usually far outweigh its higher original cost. Only two operations are necessary—placing the unit in the designated location and connecting external power, motor, and control leads.

IT'S PRE-ENGINEERED

Cabinetrol is based on the use of standard enclosures equipped with the right combination of standard control devices. Each unit is pre-engineered to meet your specific requirements. All starters and accessory equipment necessary to your application are incorporated in the Cabinetrol unit before it is shipped.

PROTECTS YOUR OPERATORS

Because metal-enclosed Cabinetrol is completely deadfront, it offers your operators and servicemen maximum protection. Each motor control is installed in an individual sheet-steel compartment with an interlocking door. Operating mechanisms for motor-circuit switches and air circuit-breakers are available from the front of the panel.

LET US HELP YOU equip your plant with co-ordinated control. We'll be glad to work with you now—to provide a Cabinetrol system specially engineered for your plant—and, if you desire, to help you fit Cabinetrol into your over-all plans.

If you'd like more facts about Cabinetrol ask for Bulletin GEA-3856. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

G-E INDUSTRIAL CONTROL

GENERAL ELECTRIC